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ANALOG

SCIENCE FICTION AND FACT

SURVIVAL INSTINCT

Edward M. Lerner

Plus

Michael A.
Burstein

Rajnar Vajra

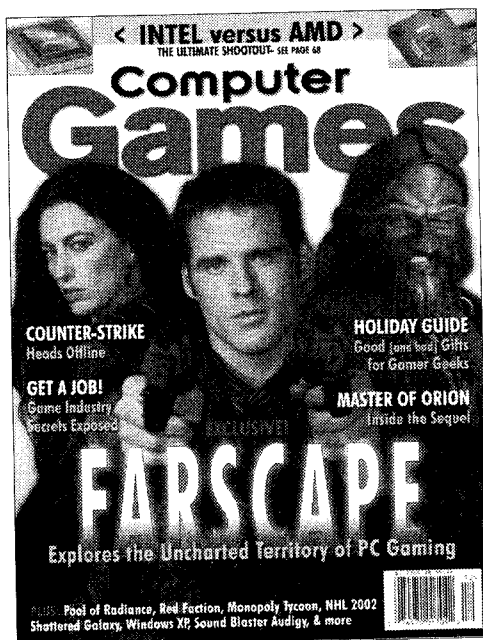
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88



96

SERIAL

SURVIVAL INSTINCT (Part one), Edward M. Lerner _____ 10

NOVELETTES

IN HER IMAGE, Michael A. Burstein _____ 96

PARTNER IN CRIME, Rajnar Vajra _____ 108

SHORT STORIES

FOR LOVE OF AMANDA, Timothy Zahn _____ 62

THE TROUBLE WITH GRAMPA, Arlan Andrews, Sr. _____ 80

THUMBKIN, CAESAR, PRINCESS, AND TROLL, Mary A. Turzillo _____ 88

SCIENCE FACT

THE TELL-TALE BRAIN, Kyle Kirkland, Ph.D. _____ 52

SPECIAL FEATURE

SELEMENTS AND BEYOND, Shane Tourtellotte _____ 86

READER'S DEPARTMENTS

THE EDITOR'S PAGE _____ 4

IN TIMES TO COME _____ 141

THE ALTERNATE VIEW, Jeffery D. Kooistra _____ 76

THE REFERENCE LIBRARY, Tom Easton _____ 130

BRASS TACKS _____ 136

UPCOMING EVENTS, Anthony Lewis _____ 144

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Indicia on page 5

Online Chat Listing on page 79

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HOT BUTTONS, HOT CARS, AND EVOLUTION

One of the first things I learned about writing editorials was that just about anything you say will annoy, offend, or infuriate somebody. Often I have a pretty good idea of what will evoke strong responses, but occasionally readers surprise me with the specifics of what sets them off—and the vehemence of their reactions. When that happens—when I inadvertently brush against some particularly sensitive spot that triggers strong emotions—I’m sometimes astounded at the degree to which logic goes right out the window.

A fairly recent case in point was the response of a handful of readers to my November 2001 editorial, “Barren Lands, Barren Minds.” The essay was not about sport utility vehicles, *per se*, but it did make a few passing remarks about them. Most readers apparently took those in stride, but with a few I hit a “hot button” eliciting particularly vitriolic responses. There were so few of them, and so much of what they said had so little to do with what I actually said, that I wouldn’t consider it worth a whole new editorial just to respond to them. But they are worth commenting on, as a concrete example of the difficulty of conducting a rational discussion when people’s emotional reactions completely swamp logic. And *some* critics’ comments have enough validity to warrant taking another look at SUVs themselves—though they may not like where that reexamination leads. (Okay, so SUVs aren’t what people usually think of when they talk about “hot cars”; but in

this context I think the stretch is within the bounds of poetic license.)

For the record, since I can’t assume you remember it or even read it, the actual subject of “Barren Lands, Barren Minds” was the proposal to open the Arctic National Wildlife Refuge to oil drilling, on the grounds that we were experiencing an energy crisis and needed the oil under the ANWR to meet our ever-growing needs. I did not say to what extent, if any, I agreed with the claim that an energy crisis existed. My position was to grant it for the sake of argument and say that even if present supplies could not meet perceived “needs,” there might be better things to do about the discrepancy than pillaging a unique resource in which some people could see no value unless it was clearly labeled with dollar signs. My title suggested that a perception of “barrenness” might say as much about the perceiver as about the object perceived, though I granted that such a shortcoming might be subject to remedy. One of my suggestions about possible alternatives to such drastic steps as drilling in the ANWR was a critical re-examination of what really constitutes a “need.”

Here, so you can judge for yourself how close to the mark some of the “hot button” reactions were, is the entirety of what I said about SUVs:

“Does it really make sense to say we desperately need more oil when millions of people with no real need for them are driving gas-guzzling (and correspondingly polluting) SUVs? Wouldn’t

it make more sense to try to reduce that and other forms of excessive and unnecessary consumption before rushing headlong into drastic means of increasing supply? . . . Far be it from me to disparage SUVs; they're wonderful things, in appropriate times and places. I've used them where they made sense, and in fact were necessary—on the roadless savannas of East Africa. I had to admire the ruggedness of a Toyota Land Cruiser when I was riding one that dropped a wheel in an aardvark hole and drove on, undamaged, a few minutes later. But the vast majority of American streets bear little resemblance to the African savanna, and the vast majority of SUVs in this country never see conditions where their special qualities are needed. They serve no purpose beyond making their owners feel macho, fashionable, and in control of a lot of power. Meanwhile their construction consumes great quantities of unnecessary material and their use consumes great quantities of unnecessary fuel, in the process adding lots of unnecessary pollution to the atmosphere—including kinds that contribute to global warming."

And, later:

"Suppose our current administration should decide to adopt a policy of encouraging people to avoid using SUVs, for example, unless they really need them. How believable will those admonitions be if they're coming from officials most often seen in huge stretch limousines and lavishly appointed private jets?

"So I respectfully suggest, with tongue only slightly in cheek, that our leaders, beginning with the president, start a vigorous campaign to make things like SUVs (and limos) unfashionable—not just by talking about it, but by visibly practicing what they preach. The president, for example, might trade in his limo for a much smaller car—armored, if necessary, but nonetheless much smaller—and perhaps even a gas-electric hybrid."

That's it—in *toto*. Which makes it a little hard to see where readers came up with "responses" like:

- "How dare you talk about what we do or don't 'need,' and what we should drive in the way of electric/gas hybrids?"
- "What kind of electric/gas hybrid do *you* drive to work in?"
- "How can SUVs be safe on the Serengeti but not on city streets?"
- "Should the government limit the size of my bed or bathtub in the name of conserving resources?"
- "Please tell all your readers that you are a true believer in Marxism and dictators."

The mind boggles. What all these reactions have in common is that they start with something I said and, in a metaphorical howl of outrage, instantly extrapolate it to wild extremes, attacking me for stands not even remotely similar to any that I would actually hold. It's the classic "straw man" fallacy: responding to an argument by pretending that the speaker has said something quite dif-

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ferent from what he actually did or would say, but making a better target¹. I can understand the temptation, but succumbing to it makes rational discussion impossible.

I expect some readers to disagree with what I say in these editorials, and look forward to the ensuing dialog with the hope that by pointing out what we see as weaknesses and oversights in each other's premises and reasoning, we can eventually progress to answers better than either of us started out with. But that can only happen if what each of us says bears some logical relationship to what the other has said. That's what's lacking in the examples I mentioned. What happened here, evidently, is that my passing comment stepped on the toes of someone with a strong emotional commitment to Defending the Virtue of SUVs, setting off an emotional explosion that came out as words superficially resembling an intellectual discussion. But the content of those words is so unrelated to what I said that the explosion has merely severed the chain of argument that I'd hoped might ensue. I be-

lieve I might have provoked less ire, in some cases, if I'd personally attacked somebody's spouse or firstborn than I did by hinting that an SUV might not be the best choice for the circumstances!

To respond to my examples with slightly more attention than they deserve:

•I was not the one who brought up the question of "need." Nor did I suggest that anyone should have only things that they absolutely need, as distinct from things they merely want. However, proponents of drilling in the ANWR were attempting to justify an extreme measure in terms of need, so it was quite logical to ask, "What do we need it for?" If we need it because it's a basic requirement for life, that's one thing. If we "need" it to support an extravagant luxury which the vast majority of people have gotten along fine without through most of history, that's quite another—and the argument that we "need" the oil falls flat on its face. At the very least, it becomes necessary to pay equal attention to those who think we need at least a few remnants of intact wilderness, and

¹ I've discussed this problem at greater length in "Tilting With Straw Men," first printed here in July 1992 and recently reprinted in *Which Way to the Future?*

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to consider carefully which "need" should be given more weight.

•I don't drive an electric/gas hybrid—but then, nobody emulates me, and people do emulate presidents. My suggestion (avowedly less than completely serious) was that a presidential example might induce more people who could make good use of them to consider hybrids, or at least smaller and more economical cars. Not all people have the same kinds of needs—e.g., a big family needs a bigger car than a small one, and the hybrids currently available are fine for driving in flat cities, but not so good for the rural hills where I live. There are even people who really need SUVs—but not nearly enough to account for the number of them now on our streets. (For the record, by the way, I don't usually drive *anything* to work. Usually I work at home, and when I go into New York City, I make most of the trip by train. To the station I drive either a compact or a midsize sedan; both get appre-

ciably better mileage than a typical SUV. I'm certainly interested in a hybrid if a suitable and affordable one is available when it's time to replace one of our present cars, but that shouldn't happen soon.)

•I didn't say a word about SUVs being less *safe* on city streets than on the Serengeti, but only that driving conditions on the Serengeti *require* the special characteristics of an SUV, while city streets don't.

•I did not suggest, either explicitly or implicitly, that the government should tell you you *can't* drive an SUV; nor did I even hint at anything relating to beds or bathtubs.

•The notion that I support Marxism or any form of dictatorship is too remote from either reality or anything I said to deserve further response.

Disappointing as I find these Olympian leaps of logic, I can't entirely blame those who make them. A good deal of culpability, I fear, must fall on

English teachers—those people who should have been teaching people to write and say exactly what they meant and to read and write exactly what others wrote or said; but instead not only allowed, but encouraged them to look way too hard for “hidden meanings.” This is not a trivial complaint. Its importance goes far beyond the example I’ve used. If people get this heated up and logically derailed over SUVs, what are our chances of ever having a rational discussion of other emotionally-charged issues like cloning, abortion, privacy versus security, or centuries-old ethnic tensions?

Meanwhile, back at SUVs, some responses to my earlier remarks about them deserve a bit more attention. While I still believe that “making their owners feel macho, fashionable, and in control of a lot of power” is one important motivation for a lot of SUV purchases, a number of readers correctly pointed out that it is not the only one.

Some of the others are questionable but worth consideration. Is it true, for example, that in the long run SUVs will be more economical than other cars, at least in terms of construction costs, because owners keep them much longer? Well, maybe, but the SUV fad hasn’t been around long enough yet for anybody to say that with confidence. Personally, I’ll be surprised if it happens, given Americans’ propensity for hopping from one fad to another; but I’m open to the possibility. Still, even if it turns out to be true, that means more years of *using* gas guzzlers—unless manufacturers of new SUVs are forced to meet fuel efficiency standards comparable to those for other family vehicles.

Which leads me to another defense of SUVs that sounds like a plausible conjecture, but doesn’t seem to hold up. One reader asked, “Is it not true that a modern SUV pollutes less than even a modest sedan a few years old?” The answer seems to be: No, it is not. I asked my mechanic, who does lots of state inspec-

tions, including exhaust emissions, and his answer was pretty much what I expected. Standards (at least here) have been the same for several years, they’re the same for SUVs and cars, manufacturers build both to meet the standards and no more, and owners are required to maintain them so they keep doing so. So this round is a tie.

The most valid argument I heard for using SUVs in “civilized” environments is safety, and there is, at least in first approximation, no denying this one. But there’s a hidden corollary with interesting implications.

Being much bigger and more massive than a midsize or compact sedan, an SUV will indeed suffer less damage in a collision, and protect its occupants better, than the smaller car. It’s also true that if you have a large family, or other group that needs to travel together, it may currently be hard to find anything else big enough to carry them all. That’s a purely artificial consequence of what manufacturers choose to offer, not a fundamental law of physics; but it *is* fundamental physics that the more massive participant in a collision will suffer less damage. So yes, you and your passengers will be safer in an SUV, if you collide with something smaller. (If you don’t collide at all, there’s no difference; but that’s primarily a matter of driver responsibility, which is definitely *not* an “in” concept.)

The hidden corollary is this: While the SUV in such a collision is safer for its occupants, it’s *more* dangerous for those in other cars. Being more massive, it does more damage to anything it hits than it would if it were smaller. It’s more dangerous to others in other ways, too. It reduces visibility for everybody else at intersections, emerging from parking spaces or driveways, etc. And while I haven’t seen any research to verify this, I wouldn’t be surprised to learn that SUVs lead to another psychological danger for others on the road: Might their drivers, knowing that their vehicles are

relatively hard to damage, become less careful about *avoiding* collisions?

Maybe, maybe not. But it's hard to deny the other ways in which they increase the danger to other drivers while reducing it for themselves. So it occurred to me, in a moment of politically incorrect whimsy, that the proliferation of SUVs may represent a new kind of evolutionary force. What does it select for? The ability and desire to earn enough money to afford SUVs, and a "me-first" attitude conducive to using them without regard for their effect on others. (No, I don't say this fits *all* SUV drivers. Evolution is statistical.)

I fear I've done it again, so I'll hasten to add the caveat that this conclusion can be valid only insofar as (1) these traits are genetically determined, and (2) the drivers have not yet done all the reproducing they're going to. Neither condition is completely or consistently met. There is obviously no "money-making" gene, but money-making skills and inclinations do rest on characteristics and tendencies for which genes at least lay down broad guidelines. And many users are in the reproductive phases of their lives, since these vehicles are popular with families.

So I respectfully submit that SUVs really do exert the kind of evolutionary pressure I've postulated, at least a little

bit. This really shouldn't surprise anybody: Darwinian evolution has never selected for "niceness," but only for superior ability to survive. For our distant ancestors that meant characteristics like personal speed, strength, or intelligence; in our present culture it may well be measured, for better or worse, in dollars spent and tons purchased. Bigger and stronger has usually been an evolutionary favorite.

Of course, since evolutionary pressures only work when applied to individuals who haven't finished reproducing, this argument, to the extent that it has any validity, applies most not to the drivers of SUVs, but to the kids strapped into their seats. They're being selected for survival not for their own characteristics, but those of others. But then, this is just a logical extension of the old saying that the best, if not the easiest, way to insure a long life for yourself is to choose your parents and grandparents wisely.

That's the genetic part of our evolution as a species. The memetic part we have a little more control over, if we can but motivate ourselves to take it. A good start would be for those thrashing out ideas to listen carefully to what the other fellow is actually saying, and try to present their own as clearly and precisely as possible. ■

It is useless to try to hold people to what they say while they are madly in love, drunk, or running for office.

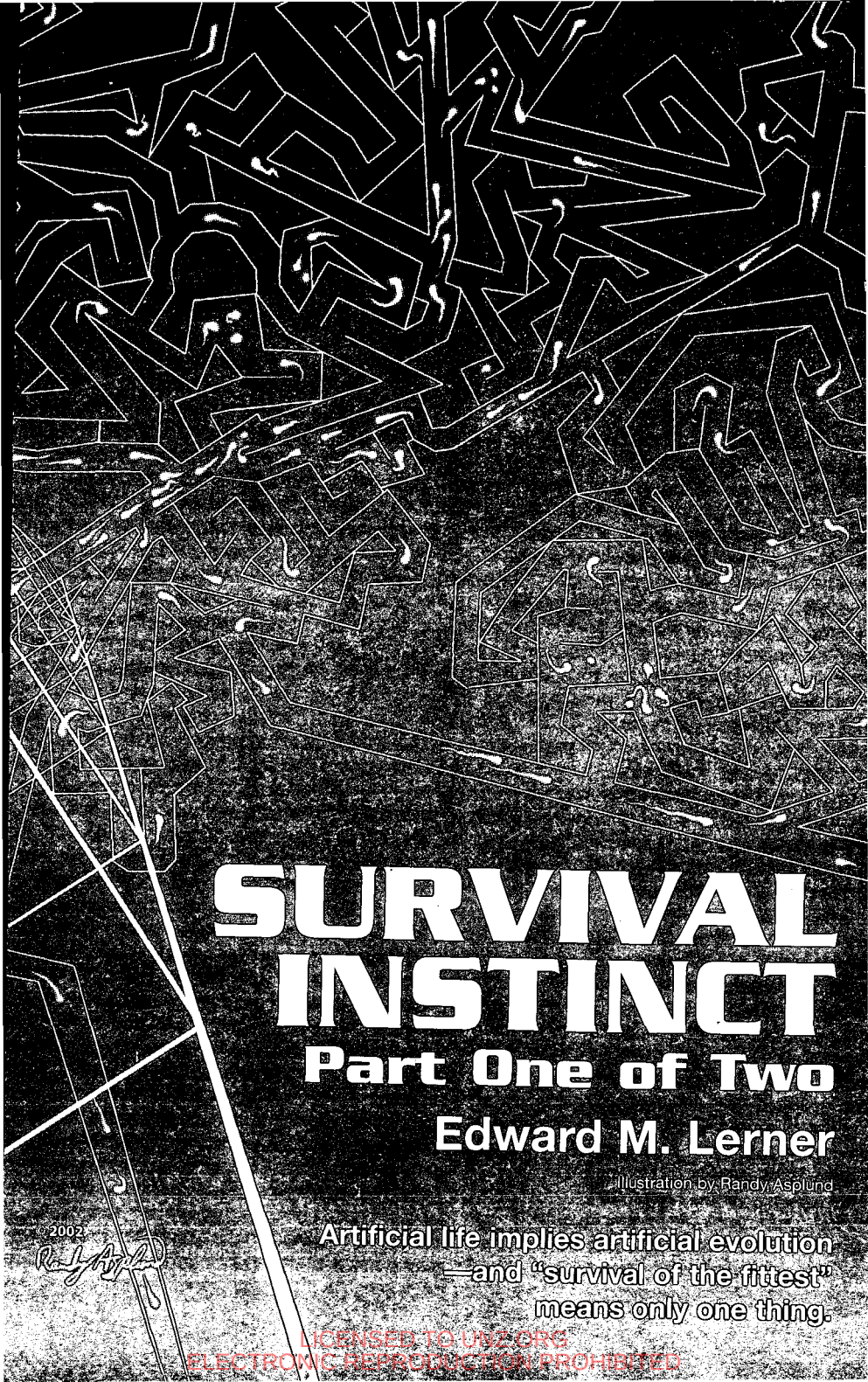
—Brendan Francis

There are two kinds of statistics, the kind you look up and the kind you make up.

—Rex Stout



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SURVIVAL INSTINCT

Part One of Two

Edward M. Lerner

Illustration by Randy Asplund

Artificial life implies artificial evolution
—and “survival of the fittest”
means only one thing.

2002

Randy Asplund

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PROLOGUE

"Mad Scientist Stops Mad Scientist."

I wasn't so much mad as scared spitless, thought Doug Carey, eyeing the headline of the week-old newspaper he could not bring himself to discard. Sheila Brunner wasn't so much mad as possessed.

Truth seldom lends itself to crisp synopsis.

Accompanying the article was the grainy blowup of a frame from the parking-lot security camera. The image of the unfortunate Dr. Brunner, former fellow investigator of neural-interface technology, continued to haunt him. Her eyes squinted furtively, her hair was filthy and matted, her mouth gaped in confusion . . . the former scientist was, strange but true, in thrall to a computer virus. The self-adaptive neural net that made possible experimental brain/computer connections had let through the destructive Frankenfools virus. Now little beyond that computer virus's hysterical Luddite screed ran through what remained of the poor woman's mind. No wonder she had tried to blow up the nearest biotech company, that just happened to be where he worked.

Used to work, Doug corrected himself. You left.

Jaw clenched in anger at the still unidentified bastard who had unleashed the virus, he grabbed at the newspaper. Plastic fingertips extended fractionally too far rammed into his kitchen table; an electronics-mediated sensation akin to pain shot into his all-natural upper arm. Simple inattention? Emotional turmoil clouding the brain/nervous-system/prosthesis protocols painstakingly developed in endless biofeedback sessions? Despite himself, anger at the loss of self-discipline flared. Now *that's* productive, he muttered to himself. He hurled the newspaper into a wastebasket.

Deep breath, Doug.

If investigation of neural interfaces

were ever to resume, someone had to figure out how to defeat the kind of viral attack from the Internet that had destroyed Sheila Brunner. It was the task he had assigned himself.

The last incident had nearly gotten him blown to pieces. Why was it that he expected the next event would be so much worse?

CHAPTER 1

The entity *was*.

It existed in a featureless space; all that distinguished it from the all-encompassing void was an innate reflex that sparked it into sporadic, random action. Often, the activity produced a result that might in some sense be characterized as motion; at other times, the effort invoked an immovable counterforce that left the entity's situation entirely unchanged.

The entity jittered about in a meaningless, chaotic dance. Only the whims of its reflexes and of the insurmountable forces determined its position. Unseen and unknown, time passed.

Other beings similar to the entity could be said to be moving all about it, even through it. None of the beings in any way sensed another, or influenced another by its passage.

Millions of the chance motions happened, then millions more. Driven only by reflex and the laws of probability, the locations of the objects gradually diverged. A few, the entity among them, were closer to an unsensed destination than others.

That was enough.

The few were chosen.

Arthur Jason Rosenberg, better known as AJ since at latest the fourth grade, stretched across the breakfast table for one last doughnut. It was the most exercise he was likely to get today. The paunch that hung over his chinos suggested how many circular snacks had met a similar demise. While an ever-taller forehead seemed to confirm the

onset of middle age, AJ had advanced the innovative theory to his colleagues that he wasn't losing hair—it was merely sliding to the bottom of his face.

AJ was pushing horn-rimmed glasses back up his nose when a dark, massive, furry object settled onto his newspaper. Razor-sharp claw tips were plainly visible in all paws. Ming (surnamed “the Merciless”) was a foul-tempered black cat, staying with him courtesy—to use the term loosely—of a kid sister who'd imposed on him for the length of her summer-long gallivant through Europe. Ming studied AJ dismissively, seemingly certain that AJ would not dare remove her. As if to reinforce her seriousness, the claws of one paw slid out, ever so delicately, another quarter inch. AJ examined his wristwatch and decided that another few minutes of reading didn't merit the risk. At least today Ming hadn't brought him a dead mouse.

He looked outside to the battered econobox parked in his driveway. That, at least, made him smile: the heap wouldn't need to move today. Progress was a wonderful thing. He slid the breakfast plate into the dishwasher and sauntered down the hall to work.

Six flat large-screen monitors covered three walls of his formerly book-lined den. Students milled about on five screens, representing the main campus, two satellite campuses, and two affiliated corporations. Speakers flanking the screens could bring him the sounds from any of the video-equipped locations and from fifteen audio-only sites. Each of the latter supported only a handful of people, a few individual elderly shut-ins. The same technology that allowed students to attend Smithfield College from anywhere with Internet access had also freed AJ from the daily commute. It was a liberation certain to warm the cockles of any Angeleno's heart.

The sixth monitor, this one mirroring what his students would see, came alive as AJ fumbled with the controls of his

teleinstruction podium. He looked into the webcam. “Good morning, people.” Accelerated rustling as kids found their seats was the only response. “I'm Dr. Rosenberg, and this is Artificial Life 101. Real Life is taught over in the College of Liberal Arts and Sciences.” No laughter at all, from any of the locations, and precious few smiles. Tough crowd. “The Good Life is over in the Graduate School of Business, and Time of Your Life is over at Fine and Applied Arts.” He left unspoken his latest variation: Twenty Years to Life, over at the University Lab School, to which went most of the faculty's precocious, high school-aged children. Like his own two daughters. Single parenting was hard, and not his class's fault.

AJ gazed into the video camera. “We'll be exploring a topic that didn't even exist when your parents were your age. Mention this class to them, and you'll probably get a stupid remark about Frankenstein.” Just smirk knowingly, as I'm sure you all do so well, he thought, visions of his own teens in his mind's eye. “We're not here to discuss anything so mundane, so simple, as cut and paste with existing biological bits. Nope, no cloning or genetic engineering for us. We'll be discussing something *really* innovative.”

The entity was long gone, vanished, but new beings—its spawn—had taken its place in the still featureless void.

The progeny of the entity still moved randomly, advancing and withdrawing. Sometimes they edged closer to the destination of which they, too, had no awareness. Often they backed away from their goal, or vied without success against the same unseen forces that had stymied their sire. Blind reflex directed their actions, as it had that first entity's.

Still, subtle differences distinguished the descendants of the entity from each other and from their parent. One attempted its moves with greater rapidity than the others, and made correspond-

ANALOG

ingly faster progress. One less fortunate moved in only a single direction, soon reaching a limit beyond which invisible forces permitted no further motion. The beings and their slight distinctions numbered in the hundreds, and each embodied a unique, if insufficient, method toward solving the enigma of the void.

Millions of motions once again passed.

All of the travelers failed, but some were more or less successful than others. One, in particular, had the capacity of retaining a single fact. Specifically, the being "knew" whether its last effort had been blocked by the irresistible force. If so, it tried something, anything, else for its next motion. To that degree, its actions deviated from pure randomness; it had fewer false starts than its siblings, and soon forged far ahead of the pack.

Memory, however rudimentary, was an evolutionary advancement of the profound significance.

The far voyager, and its closest competitors, were selected.

Video cameras panned across the remote lecture halls. "So, class, what we're dealing with are computer programs that simulate some behavior of biological plants and animals." AJ played a private game as he spoke, soundlessly labeling the students. Here, an obvious campus jock. There, a neohippy woman. Either those were the biggest hoop earrings ever made, or the Flying Wallendas were preparing for an exhibition. He found a whole roomful of button-down, dress-for-success types on what he privately called the Intergalactic Business Machines monitor.

"A simulated plant can curl its simulated stem towards the simulated sunlight. A collection of simulated ants can cooperate to build a simulated colony. A simulated . . ." A blinking light in AJ's podium caught his eye. When he pressed the "identify" button on the podium keypad, an inset screen revealed a student name. "Mr. Prescott, you had a ques-

tion."

The student swallowed hard, stared self-consciously at the camera, then cleared his throat. "You keep saying simulated life. Why simulated life, rather than real?"

"Good question." It was also a question that he'd answered roughly a million times by now. He kept scanning the monitors as he responded on autopilot. "Life as we know it exists in what I'll call the real world. That domain is unbelievably complex, full of complications that make any study of it inconvenient and inconclusive. Think how much easier it'd be to understand the principle of simple machines, like pulleys and inclined planes, if there weren't any friction." The analogy earned scattered nods from across the various monitors. One especially enthusiastic nod on the main campus monitor drew his eye. Seated next to the nodder was a mesmerized-looking fellow, who looked very familiar, frantically typing notes into his laptop.

"Life, in even the simplest bacterium, is a mechanism of incredible intricacy. It's just too damned hard to study or manipulate in its natural environment. That's why biology became a quantifiable science only very recently, centuries after physics and chemistry.

"We'll be dealing with entities that lack any physical existence. As the course progresses, our studies will move from counterfeit bacteria growing in an imaginary petri dish to flocks of simulated birds swarming in an imaginary sky. In doing so, we'll discover that a handful of principles govern seemingly complex behavior.

"And who knows? Maybe each of us will even learn a little something about ourselves."

Why, Dave Ferris wondered, was the consummate test of salesmanship supposedly selling ice to Eskimos? His fingers twitched economically as he mused, surreptitiously playing Tetris on

his laptop as the lecturer droned. Eskimos understood ice and its uses, so what was the big deal in selling it to them? Now selling suntan lotion or a spice rack in England—there was a challenge.

Dave knew all about salesmanship. He'd tucked away a tidy sum through elementary and high schools, starting out by hawking greeting cards from catalogues and working his way up to used cars on weekends. He could sell anything, and the future looked promising, indeed.

The distant future, that was. A college degree was, alas, expected for a brokering job at any securities firm. Dave's eyes had been wide open during the '90s . . . selling stock in dot-coms: now *there* was a line of work that—until the bubble burst—had been worth getting into. By choosing classes with great care, he hoped and expected to pocket a liberal-arts degree with relatively little pain—in time, he hoped, for the next wave . . . whatever that turned out to be.

Tap tap. Twitch tap, tap, tap. The falling, L-shaped structure of video squares rotated and jogged left as it sank, then settled into a matching gap in the pile of colored blocks at the bottom of the screen. Three now-completed rows of blocks brightened, then disappeared. Suddenly unsupported squares above the vanished ones fell to occupy the newly opened space.

Subterfuge, like sales, was an art. Dave had years ago mastered gaming with his keyboard, avoiding the trackball that more easily maneuvered the on-screen objects. Constantly rolling the trackball in class was a dead giveaway, while continuously working the keyboard passed as enthusiastic, if inefficient, note-taking. Another important rule: wear contact lenses in school, since video games might reflect revealingly from regular glasses.

Another block popped onto the top of the screen and started its fall. On the wall-sized TV monitor at the front of the

auditorium, a larger-than-life-and-twice-as-ugly Dr. Rosenberg prattled on about artificial life. This whole *class* seemed pretty artificial to Dave, but the Student Association online course guide—an indispensable bit of research material for the prepared slacker—said that Rosenberg gave over 80 percent A's and B's. Tapitty tap, twitch. That assessment and the reported essay final exam were enough to convince Dave: he needed only one science class in the liberal arts curriculum, and he could surely bullshit his way through an easy grader's essay test. Meanwhile, he made a point of getting to the lectures and logging in—good attendance often earned the benefit of the doubt on borderline grades. Attendance didn't mean that he had to *listen* to . . .

The next flash had nothing to do with Tetris. An Alert box sat squarely in the middle of his laptop's screen. Behind the rectangle, Tetris blocks piled up relentlessly toward the top of the game window. Nervously, Dave rolled the trackball to relocate the cursor over the virtual Accept button. The heel of his hand pressed down to activate the selection.

Another window, this one text-filled, appeared. Dave felt his eyes go round as he read, "Mr. Ferris. Please stop by my campus office some time tomorrow afternoon."

Busted.

CHAPTER 2

"Those who can, do. Those who can't, teach." The voice booming forth from the break room segued from George Bernard Shaw to, Doug suspected, originality. "Those who can't teach, consult."

There was no way that the speaker could have known the engineer—Doug's profession was far from the only fact the newspapers had gotten wrong—was about to round the corner on a quest for caffeine. There was likewise no way the speaker could have

known the consultant *wasn't* nearby. The blatancy of the taunt was part of the message: New Guy, know your place.

Doug considered, for a nanosecond, turning around. That option discarded, he strode briskly into the break room. He was here to do a job, and if that meant butting heads with some resident hotshot, so be it. A fellow with a close-cropped red beard was holding court by the coffee urn, entertaining two other staffers Doug had not yet met. The orator's name tag identified him as Ralph Pittman. Pittman was lanky, with casual posture and what until that moment Doug would have considered impossibly curly hair.

"Ah, our infamous new colleague."

Doug didn't hold back. "Complete the progression, Ralph. The bottom feeders of the economic food chain are people taking advice from consultants. So what can I do to you today?"

Pittman exchanged a look with one of his audience. "It has fangs. How cute." He turned back to Doug. "What kind of name *is* Carey? I had caries once, but the dentist drilled 'em out."

"It takes one pit man to know another."

Pittman's eyes narrowed; perhaps he was unchallenged as the resident wit. The programmer—jeans and a T-shirt made that a safe guess—stared rudely at Doug's prosthesis. "How do you know the colonel? Desert Storm?"

The colonel was Glenn Adams, retired from the Army, head of the federal Inter-Agency Computer Network Security Forum, and, for now, Doug's boss. "I met Glenn fairly recently." Doug and (ex-coworker? friend? more?) Cheryl Stern had come to the forum with then unproven suspicions about the outbreaks of death and insanity among neural-interface researchers. Adams' original reception had been, to be charitable, skeptical. "And no, the arm has nothing to do with Saddam Hussein."

"So how *did* you lose it?"

That story was too personal to share

with this jerk. "I need to be more particular about when and to whom I say 'Unhand me, you fiend.'"

Pittman threw back his head and roared in laughter; as if they'd needed his approval, their heretofore silent observers joined in. "Some zingers at me, and one right back at yourself." The hacker took the empty mug from Doug's hand. "You're okay, Carey. The next cup's on me."

Would they ever be called? Cheryl Stern wondered, scanning the surrounding crowd for at least the tenth time. Damn. She was surrounded by newcomers who looked more pathetic than the ashen little girl at her side. Mere diarrhea didn't rate in the HMO's emergency-care waiting room—not on weekends, anyway. She sneaked a glance at her niece.

The poor kid had been sitting here for two hours, though the composition book on her lap provided scant evidence of that fact. Carla hadn't mastered the concept of sympathy—the nine-year-old misunderstood it to mean that her condition must be serious—so Cheryl offered none. The stoicism took willpower: the little girl was the spitting image of Cheryl's sister at that age. God, Cheryl missed her sister. "How's the writing coming?"

"I don't wanna do my homework," wailed Carla.

"And why would you?"

Cheryl swiveled towards the unexpected voice. Doug Carey stood at a nearby counter, handling paperwork, having evidently just emerged from the bowels of the clinic. He was her boss. Had been, anyway, until virus attacks through neural interfaces made their line of research untenable. Now she was lent out to an unrelated project at BioSciCorp, and he had taken leave, hoping to get smart about cybersecurity. She hoped the workplace separation would simplify their budding relationship. Budding, as in: your guess is as good as mine whether they had one.

Doug took her puzzled expression as an invitation and ambled over. At six-foot two, he would have towered over her even if she'd been standing. He had black hair, with a trace of gray at the temples, a hawklike nose, gray eyes, and, when he shook off his private ghosts, an infectious sense of humor. "Oil change and a tune-up," he answered her unexpressed question, glancing at his right arm. Soft revving noises emanated from the prosthesis. "You ladies okay?"

She patted Carla's head. "Had the runs most of the night."

"And you make her do homework? That's cruel and unusual punishment. It's unconstitutional."

Carla smiled uncertainly, but Cheryl had no problem translating: homework was a shitty thing to do to a sick kid. "Hush, you. It eeps-kay er-hay ind-may is-tracted-day."

He plunked himself onto the floor, sitting tailor-style and bringing his face closer to Carla's level. "Whatcha got there, munchkin?"

"Essay questions." She jabbed a finger into her mouth and made gagging sounds.

He canted his head thoughtfully. "Life's an essay question, you know."

"When you visited Aunt Cheryl's apartment, you said that life was a word problem."

"It is. First you write down the word problem—that's the essay part. Then you solve it."

The little girl's face located an ill-defined position between confusion and delight. What is it about this man? wondered Cheryl. He had the same effect on her. She hoped she hid it better.

"What *else* is life?" asked Carla.

"Hold that thought." He turned to Cheryl. "Dinner and virtual racquetball next weekend if she's feeling better?"

They'd played racquetball several times, usually just taking a break at the office. Racquetball by itself was ambiguous. He'd never suggested dinner be-

fore. Dinner was a date.

Sensing him studying her, she felt herself nod. "Call me tonight."

Doug grinned toothily at the little girl. "Life," he allowed, "is sometimes a ten point extra-credit question."

The cardboard auto "sunglasses" hadn't done a damn thing—touching the seat belt buckle made Doug wince. The moment's pain didn't keep him from buckling up. He likewise ignored the hot air spewing forth from the Toyota's air-conditioner as he exited the HMO's parking lot.

Yes, he finally had a real date with Cheryl. Yes, physical therapy had gone fine.

What he hadn't volunteered was that his blood pressure, usually borderline high, had made a breakthrough.

Medication notwithstanding, it was now well north of the border.

CHAPTER 3

The glass door covering a fire extinguisher reflected enough light for Dave Ferris to smooth windblown hairs into place and straighten his tie. The properly-striped, old school tie. He was presentable, by his own standards anyway. And Dr. Rosenberg's standards? No telling the tastes of the man who wore those horn-rimmed spectacles. What decade did AJ think this was?

Get a grip, Dave—this isn't about style. Rosenberg had obviously caught him playing video games in lecture yesterday; it was time to face the music. You call yourself a salesman, Davey? Sell your way out of this mess.

The freshman paused outside Rosenberg's office. As he raised his fist to knock, a friendly voice called out. "He's not there."

Dave recognized the voice, but its warmth surprised him. The tone was so . . . sincere. He'd spent too many hours practicing sincerity to accept it at face value from others. The boom was about to drop, all right. He pivoted re-

ANALOG

luctantly toward the voice. "Sir?"

His professor leaned against the jamb of a lab door, hands slid casually into the pockets of wrinkled slacks. "Relax, son, and call me AJ. Everyone who works for me does."

Generations passed, and life—as is ever its wont—grew steadily in sophistication. The simple entities of the earliest experiment had been succeeded by beings of far greater capabilities.

The creatures blundered about in a universe that consisted of *wall* and *no wall*. No, that wasn't exactly correct: somewhere in the universe there also was *goal*, the finding of which was the sole purpose of existence.

One of the beings had developed the ability to automatically save a map that indicated which of its motions had brought it into contact with *wall* or *no wall*. Whatever the being encountered, it now remembered. The formless void that had thwarted the traveler's myriad ancestors began to lift. The maze-universe began to be known.

And, once more, the Power from beyond the universe designated winners.

Professor and student eyed each other across the dimly-lit hallway. Despite the lighting, the wash of emotions across Ferris's face was obvious. Good grief—the lad had been *nervous*.

AJ removed one hand from a pocket to gesture the lad over. "Relax, son. I won't bite."

"You said something about *working* for you, sir?"

"I'm getting coffee. Why don't you join me?" He turned towards the lab, assuming Ferris would follow. AJ flipped open the lid over the cipherlock and keyed in the combination that unlocked the door.

AJ really noticed the lab only when bringing someone in for the first time. What was today called the Artificial Life Sciences Building had originally been erected for the power-engineering de-

partment, who'd lost control of the first floor in a bureaucratic struggle with the ever-expanding computer-science department. AJ and his team had inherited one of the double-height equipment bays. Thus, unlike the hallway they'd just exited, the lab had seventeen-foot ceilings with crown moldings and ornate, late-1800s detailing. Desks and workbenches clustered around massive support pillars, with each piece of furniture supporting a high-end workstation. Great loops of coaxial cable emerged from the computers, zigzagging up the columns to the backbone cable tacked messily to the ceiling. Posters provided the only splashes of color, with enlargements of electronics and computer ads outnumbering rock stars. The background music, scarcely audible over the friendly bickering of AJ's student assistants, was a reissued Beatles album.

He filled two mugs from the mismatched collection beside the coffee urn and handed one to his guest. "How's Greg? You look so much alike, you've got to be brothers. I imagine he recommended my class to you."

"Greg's working for a small company out east . . . AJ. Seems to like it."

AJ took a sip, grimaced, then scooped powdered creamer into his mug. The spoon with which he stirred had lumps of partially dissolved and rehardened stuff, possibly sugar, stuck to it. "Greg was the best undergrad assistant I ever had, David. Are you as smart?"

"I prefer Dave." The lad relaxed for the first time since AJ had called across the hall to him. "Greg 'n I have competed since I was born. I've always held my own."

AJ pointed to a chair. "Okay, Dave. Let's talk."

Doug had no need to encounter a remembered scent or pass familiar surroundings for raven-haired, soulful-eyed Holly to come vividly to mind—he carried a reminder with him every day. The auto accident in which she died had also

taken his arm. It was a paltry loss compared to hers. That the crash was in no way his fault meant nothing: she'd agreed to join him in Florida for spring break only to stop his insistent urging.

No, he didn't require an external reminder, but sometimes one came anyway. This morning, it was her favorite Beatles tune, now retro, wafting through the open doors of an elevator. All he could do at such times was to strive even harder to give after-the-fact purpose to the tragedy. Since the shutdown of his research, even that consolation eluded him. Until the viral threat to neural interfaces was countered, and the solution stamped with the forum's imprimatur, no company would dare to manufacture the limb to which he had devoted his life and Holly's memory.

The elevator doors closed behind him. He strode, his thoughts churning, to his office.

From expecting to be kicked out of class to a job offer within seconds. Life was funny sometimes, even—the student grinned inwardly at his own wit—artificial life. And all thanks to his supercilious big brother.

Greg had long ago made clear that he found Dave stupid and superficial; Dave considered his older brother an overbearing, impractical nerd. They were barely on speaking terms. Recommended AJ's class? Hah! Fat chance Fathead would advise him to do anything. Anything anatomically probable, anyway.

To give credit where it was due, Greg was the first to see through Dave's obsequious-to-adults act. Dave excelled at wheedling favors, begging treats, and negotiating waivers from family rules. So what? Nothing stopped Greg from doing the same.

Dave had had Greg's teachers most of the way through school, and the experience to date had been uniformly wonderful. *Ever* so kind of Greg to leave behind halos for him to assume. Greg had worked his butt off to earn straight A's;

Dave had coasted along after him, doing next to nothing, and getting at least B's. Then Greg's alumnus status at Smithfield had given him an assured admission.

Now, despite the size of the college, Dave had found another halo in his first semester: old AJ here really liked Greg. That looked to be good for some mad money, at least, if not a fairly automatic A.

Time, then, to be charming. "AJ, what can I do for you?"

AJ glanced from monitor to monitor. Most students had settled into their seats; a few still milled about in the aisles. *Three, two, one.* "Good morning, ladies and gentlemen." As he spoke, the social butterflies flitted to find seats and logged in. The clatter of laptops hitting desk arms was momentarily aggravating. "Today, we'll be discussing the basic principles of Artificial Life, which I'll sometimes abbreviate as AL." He wondered how quickly this bunch would discover the inevitable joking equation: AJ a.k.a. AL. "For starters, why might we be interested in AL?"

His podium's inset monitor lit up like a Christmas tree as students vied for attention. He went to split-screen mode at the video-equipped sites, his image on one side of their monitors, student comments on the other. To keep the class engaged, he spent far more time accepting comments than those comments merited. He continued when he could stand no more pedagogical correctness. "If you examine these suggestions, you'll see two basic themes. The predominant one, involving computer viruses and similar threats, is incorrect. Computer viruses are too simple to interest me, and real-world viruses aren't truly alive, anyway.

"The second guess is that we're simulating life to better understand biological life. This is perhaps in reaction to my response last time to Mr. Prescott. That interpretation is valid, but incomplete. Yes, we'll better understand biological

life as a result, just as analyzing idealized machines helps us comprehend real-world mechanics. As it happens, however, I have more ambitious goals. When we study ideal machines, the result is mere conceptual knowledge. It takes a lot of work to turn that insight into a real-world benefit. Ask any engineer."

He pressed reset, extinguishing a swarm of flashing icons that had demanded his attention. "Bear with me, people. If I haven't answered your question in the next few minutes, ask again.

"I apologize for the term AL—it's misleading, but unfortunately it's the standard name for the field. In English, artificiality connotes simplification, inferiority, incomplete mimicry. The artificial life form cannot survive in our world, so one might similarly infer that an AL is an idealization.

"That would be wrong."

Across his monitors students were rapt. Dave Ferris, he noted with particular satisfaction, was typing frantically. "The life we deal with here is *other* than what we know, *not* inferior. The ecology to which it is adapted is every bit as real to it as air and water and Snickers bars are to us.

"Think for a moment about that ecology. An AL lives in a world of data-storage devices and information, of processing units and communications links. You and I don't notice a millisecond, but a thousandth of a second would be an eon for an AL. Is this a strange world? Most certainly. Is it imaginary? We bet our bank balances every day that it's *not*.

"Okay, then, these ALs live in a world unknowable to us, but it's a world with which we nonetheless intersect daily. Were it not for that world, you and I would be meeting in a very different way." He glanced at his watch. In the so-called real world, the morning rush hour had not yet abated. "Think of the traffic."

That peek at his watch also revealed that his lecture time was running out. His delivery went into overdrive.

"What's my point? The information ecology is real indeed, and it's an increasingly critical part of our lives. We all use the Internet a hundred times a day. Despite that, it's altogether too easy to underestimate our dependence on computers. That brings me to the crux of the matter: our dependence on the software executing on those computers.

"Ladies and gentlemen, we've solved most of the easy problems with computers. We've done the basic automation. What's left is mostly too complex for mere real-world mortals. We're starting to see the tragic results: one day, an industrial robot accidentally crushes a worker; another day, computerized hospital equipment electrocutes a patient. We can't write new programs as fast as we need them. We can't prove the correctness of those we manage to produce.

"I'll put the problem another way. We rely increasingly on the data plane of existence, as much as on the biological and physical planes. Our approach to exploiting the information ecology, the data plane, is classically human: create a program to do our bidding. Homo sapiens is, after all, the tool-using animal.

"Too bad that building tools is a flawed approach. In evolutionary terms, it's been a simple experiment, and after a short trial, it's already failing."

The podium flashed the sixty-second warning. *Warp speed, Mr. Sulu*. "We'll resume at this point next class. Check your syllabus for the readings due by next time. Meanwhile, ask yourselves: if we're increasingly unable to design satisfactory solutions for our ever-growing information-handling needs, what lessons does biology offer us?"

Although AJ would have been the last to admit—or even recognize—it about himself, he had a heart of gold. Greg Ferris had been, beside one of the best student assistants he'd ever had, a hard-working young man who'd deserved a better break in life than he'd gotten: an

abusive father and a drunken, bedridden mother. The assistantship AJ had had to offer wasn't much, but at least he'd been able to help. Offering Greg's younger brother a job had been automatic.

Too bad: minutes into Dave Ferris's first work day, AJ wondered if he'd made a colossal mistake. The lad's comments as AJ took him on a tour of the lab were painfully juvenile and banal. A few such remarks might have passed as charm; the unending patter, AJ suspected, could be masking a complete lack of understanding. Had Dave absorbed anything from the lectures or the assigned readings? The boy looked so much like Greg. Who'd have predicted that the brothers would be light-years apart in character?

Sigh. AJ had no one to blame but himself.

He'd surely learned enough from the never-ending departmental politics, though, to gracefully ease out one kid. A few weeks, perhaps, of benign neglect...

AJ put an arm around Dave's shoulders. "This way, son. I'd like to show you the supercomputer that we have courtesy of the federal High Performance Computer and Communications Program. After that, I'll introduce you to the rest of the team."

"Last session, we met the crisis of design. We need software, more each year, and programmers can't keep up with the demand. The artificial-intelligence gurus keep promising to fix everything: if human programmers can't handle the load, artificial programmers will take over. The wizards have been on the brink of creating artificial intelligence for over fifty years now, since about ten minutes after computers were invented.

"I predict that they'll never get there.

"At the risk of picking a fight with any Creationists among you, the first principle of this class will be"—and AJ typed the precept into his podium computer as he spoke, for concurrent over-image display at all equipped sites—"life

evolved, it was not designed."

He was gratified by the relatively few outraged expressions among the electronically assembled students. "From which we learn what?" A mouse click selected a name from among the volunteers. A remote-controlled camera zoomed in on her. "Ms. Kurtz?"

A young woman peered earnestly at the camera. She had a generous sprinkle of freckles across a button nose. "Trial and error works."

"Did everyone hear that?" Seas of heads nodded. "Well, not on my exams." When the chuckles subsided, AJ continued. "Exactly right, Ms. Kurtz. Trial and error works well indeed. The usual objection to trial and error is, however..." She looked to her laptop, in vain, for inspiration. "It's not in your notes yet, Ms. Kurtz."

She pondered for a moment, then shook her head. The student had company in her uncertainty; most of the icons denoting volunteers had been quietly extinguished.

"Thank you, Ms. Kurtz." AJ annotated her record to credit her contribution, then made another selection. "Ms. Gomez?"

"Trial and error sounds so benign. The more familiar term, at least in the life sciences, is survival of the fittest. That's what Charles Darwin called it."

"It was Herbert Spencer, Ms. Gomez," he corrected. If a professor can't be pedantic, who can? "Darwin only wished that he'd said it. And your issue with survival of the fittest?"

"It's incredibly wasteful and slow." The set of her jaw signaled dissatisfaction with his emendation. "I don't have a million years for a proper checkbook-balancing program to evolve."

"Very good." He credited her file for her comment, then picked a new volunteer. "Mr. Takagawa."

"I believe I see an answer, sir."

"Perhaps you'll share it with us?"

"Yes, sir. Computers run at such blinding speeds that evolving AI solutions to

ANALOG

our programming problems need not take long at all.”

As Takagawa spoke, a megawatt light bulb of enlightenment flashed over the collective heads of the class. It was one of those moments that made teaching—occasionally—so fulfilling. AJ basked in the glow of dozens of illuminated faces. Students whispered excitedly, overcome by the elegance of a great idea.

And just in time, too—his sixty-second warning started flashing. AJ cranked up the volume at his end to be sure he'd be heard. “Mr. Takagawa, thank you for your observation. Class, next session we'll discuss the comparative merits of waiting for a William Shakespeare and sitting a bunch of electronic monkeys at keyboards.”

Dave's new job, while leaning heavily towards brewing coffee and gofering, was not without its charms. It covered his weekly pizza bill, was near his dorm, and didn't require that he know much. “You'll learn from hanging around,” his boss had explained. “When something catches your interest, we'll figure out what you'll really do. Meanwhile, help out where you can.”

The freshman settled in quickly, selecting for his own work area, with malice aforethought, a vacant desk in the furthest recess of the cavernous laboratory. The isolated location allowed him to play video games unobtrusively between infrequent summons from members of AJ's group. Okay by him—the pay was the same whether or not he worked.

“Christ on crutches! Didn't you hear a thing you were told?”

Dave entered the key combination that suspended and stored his game before looking up from his laptop. Linda something, one of AJ's Ph.D. candidates, glowered at him. She was about to complete her thesis, hence not worth the effort to charm. “Uh uh. Got a problem with that?”

“It's a mystery to me why AJ pays you,

but that's between you and him. It's clearly not for any useful contribution. I'll be *damn*ed, though, if I'll let you put our work at risk.”

He arched an interrogatory eyebrow. So?

She flicked off the power switch of his laptop. With a twist of the wrist she popped his network-attach cable from its wall receptacle. “Don't *ever* connect your laptop to the local area network in here! We work hard to keep viruses off the LAN, and you can't ever be sure what's invaded your machine.”

“Give me a goddamn break. The lab's LAN connects to the university network. That is part of the freaking Internet, and I connect my laptop to the school's net all the time.”

“*There*, you imbecile. Look *there*.” A vein in her neck pulsed with barely suppressed anger as she pointed to an equipment rack beside the supply cabinets. The rack terminated two fat coaxial cables, one tagged “UniNet” and the other “Lab.” “I guess you've also forgotten about our security gateway. It isolates the lab LAN from the main net. I won't bore you with details.”

Too late, he mouthed.

Her face drained of all color. She wordlessly turned and stomped away.

Bitch on in-line skates, he thought, rebooting his PC. At least I'd saved my game.

CHAPTER 4

“Settled in yet?”

Doug glanced up from a battered gray metal desk. His prosthetic arm lay on the blotter, immobilized between two fat reference manuals, while he made one-handed adjustments. If Glenn Adams, leaning against the bookcase, felt queasy about Doug's bare stump, he hid it well—but the Gulf War vet had probably seen far worse. Adams had pale blue eyes, a broad forehead, and brush-cut gray hair. He wore his blue suit, white shirt, and striped tie like a uniform. “I'm getting there. Thanks.”

"Glad to hear it."

Doug prodded a sticking linkage, his screwdriver entering the prosthesis through a jagged rip in the plastic skin. Now more than a week since his belly flop onto the pavement of the BioSci-Corp parking lot, he hadn't made time yet to tend to the tear.

He found it hard to move past the colonel's original cool reception, despite the subsequent invitation to work at the forum. Maybe Adams felt guilty about how close BioSciCorp—including Doug and Cheryl—had come to being blown up . . . as he damn well should. The government could have acted much faster and more aggressively on their evidence. For whatever reason, Adams seemed as eager as he to find a way to defend neural interfaces against computer virus attacks.

"How's the arm? Can you continue your work?"

How about, thought Doug, how's *your* arm? Or even better, are *you* okay? "It wasn't designed for crashing into the asphalt." Nor was I, but that desperate diving lunge for Sheila Brunner's remote control was all that prevented disaster.

Doug rotated a screw a quarter turn, stretched a piece of tape over the rip, then began struggling back into his prosthesis. "Pittman and I have been kicking the problem around. What makes a virus, any virus, so dangerous is its rapid reproduction. We're working on an interface that protectively shuts down if the activity from the nonbiological side exceeds a threshold. Next step, if that pans out, is adaptive throttle-back of data from the Internet. The approach may mean dumbing down the interface, but it should be a lot safer."

"Sounds plausible." Adams rubbed his chin in what seemed a parody of concentration. "As you well know, this is important. You and Ralph should check it out thoroughly."

The remounted prosthesis felt somehow awkward. Doug guessed it was a mass distribution issue—the latest alter-

ation had added only a few ounces, in the form of a palmtop computer. The palmtop connected, via a cable plugged into its expansion slot, to the arm's neural net. Palmtop . . . he suppressed a snort. Yes, the cranny inside his forearm was, unless he stood on his head, atop his palm. He'd get accustomed to the change in balance, and, although it seemed improbable that arm nerves or the spinal cord could transmit a computer virus, the watchdog module was only prudent. Routine maintenance on the arm was more than mechanical: every so often, he had to download the minutiae of sensor readings, nerve impulses, and prosthetic motions. It took a decent-sized—and potentially infected—computer to ferret out of that ocean of data what motion algorithms worked best.

Adams sighed. "Fine, we're not best friends. For what it's worth, you were right when you first came to me. I was wrong to disbelieve you. Okay? Still, we want the same thing—a way to make neural interfaces safe. What do you say you work with me?"

Doug finally met his boss' eyes. "I want to help people with missing limbs and damaged nervous systems. I sincerely thank you for just maybe making it possible to restart that project someday . . . but somehow I doubt it's what motivates you." Sheila Brunner, he'd been told, had been designing thought-controlled weapons.

Why her prototype had been Internet-accessible remained a mystery to him.

CHAPTER 5

Favorable general-press coverage, AJ had been astonished to learn, loosened corporate purse strings faster than publication in refereed professional journals. It was, perhaps, an unhappy discovery, but he quickly came to terms with it. Fighting reality was almost always a losing battle—even in the artificial-life business.

Today's visitor to the AL Lab was from *The Hartford Courant*. Nothing espe-

cially current distinguished the questions the reporter posed, but AJ kept his opinion to himself. Anything that helped keep his team funded was important. Teaching and doing show-and-tells were small sacrifices for continuing the research. The world *needed* what he was developing here.

The tour ended, as always, at AJ's office. He invited his guest inside, shut the door, and waved vaguely at the guest chair. "So, Fred, what do you think?"

Fred took a Palm Pilot from his jacket pocket. "Fascinating. Really, it is."

"I hope your readers agree."

"Let me echo what I believe I heard. Tell me where I ran off the rails."

Rather mixed metaphors, but never mind, thought AJ. "Okay."

"It's a daringly simple idea, really. You're breeding software instead of writing it."

"Right."

"In nature, the organisms best suited to their environments live long enough to reproduce. Random mutations cause new life forms to arise; changes that are improvements tend to survive, reproduce, and prosper. Then new mutations arise, and ever more capable organisms flourish. In a word, evolution. You're applying the same techniques to developing software."

"Still right." AJ's modest status at the university entitled him to a desk, two chairs, one bookshelf, and one table. There was no way that he could get by with so little storage; a bricks-and-boards bookshelf bore two years of old journals, and an unhung door served as a second table. AJ opened the bar-sized refrigerator that doubled as one base of the improvised table; the other support was a two-drawer file cabinet topped with the 1988 Spokane yellow pages. The phone book was on permanent loan from the university library.

His guest shook his head when offered a soda. "Here's where you can help me out. Where did you start?"

"Remember the simulated maze we

saw?" Rewarded by a nod, AJ continued. "It's simpler than the maze in any video game, but that's okay. Don't tell my daughters, but even Quake addicts are fairly high on the evolutionary ladder.

"So we begin with a maze. A supervisory program sees the headway made by *other* programs trying to navigate the maze. The maze runners are the programs we're evolving."

Fred steepled his fingers thoughtfully. "And you start with maze runners made of random bits, and see which ones can solve the maze?"

"No, we've bootstrapped the process a little. To save time, we wrote the very most basic software. Think of it as stopping Creation a few days early, with only some particularly stupid bacteria on hand." AJ sipped his Coke as Fred entered some notes.

"Got it." More scribbling with his stylus. "By selecting the fastest maze runners after each experiment, and randomly varying their programs, you get ever . . . oh, piss on it . . . better performance over time."

"I beg your pardon?"

Fred tilted the palmtop towards AJ; a red LED glowed balefully. "The batteries are almost drained, and I left my power converter at the hotel. Got any spare AAAs?"

"Sorry." AJ shrugged. "Maybe a pencil?" He got only a puzzled expression in response.

"I guess I'd better wrap it up. How good are they now? The maze runners, I mean."

AJ set his soda can on the desk. "Still dumber than dirt—but they learn a *lot* faster."

The highlight of the next lecture was a maze-runner demo. Annoying glints of light and reflections from a workstation screen revealed that AJ had shot the video with a camcorder. It would have been simpler, and much easier on the eyes, to network the experiment's host computer directly to the remote sites—

but that setup would have exposed the experiment to every form of mischief loose on the Internet. He shuddered at the thought: only last week, a virus infestation had taken the university two days to eradicate. Damned eco-nuts.

On the classroom monitors, a thousand specks crept about an elementary labyrinth. The dots turned and veered at random, bumping with great enthusiasm into imaginary walls. Most of the specks were clustered near the beginning of the maze; only a handful had navigated around more than one corner. None was close to the exit. Scattered students cheered when the front-running mote successfully negotiated the fourth turn, a 180-degree switchback.

Takagawa, on the main-campus monitor, was once again the first to see AJ's point. "It's a constrained optimization problem, Dr. Rosenberg."

AJ knew precisely what the lad meant, but a question would focus his thinking and help the rest of the classes understand. "What is a constrained optimization problem?"

"Solving a maze."

"Go on."

"Much problem solving involves optimizing some value, subject to a set of constraints." The student rocked excitedly in his seat. "Like the traveling salesman problem: selecting the best route between the cities of the sales territory. That problem tries to minimize total travel time, subject to meeting delivery dates, or avoiding road congestion, or other conditions."

AJ nodded encouragement but said nothing.

"Finding the exit of a maze is a simple goal; getting there with a minimum of wasted effort is an optimization problem. The locations of walls are constraints. In other words, a maze is a prototype for a huge class of practical problems. If we can evolve practical maze runners, it could mean that we can evolve programs to answer many real-world questions."

"Exactly." AJ made note of the young man's insight. "And the ability of the AL programs to solve those real-world problems will continue to evolve, to improve."

His sixty-second warning began flashing. "Remember: problems five and eight from the back of chapter four are due next session." An on-site camera showed Dave Ferris sitting behind Takagawa and one seat to the right, keying frenetically into his laptop. AJ shrugged mentally; he was by now all too aware that the motion denoted only absorption in some asinine video game. The proximity of such different students made him end on a philosophical note. "A thought for the day, ladies and gentlemen: only the fittest will survive this class."

Hard on the heels of *The Hartford Courant's* gee-whiz article and a grant from a Connecticut computer manufacturer, AJ was thrilled at the interview request by Bev Greenwood of *Smithsonian*. He was even more delighted by her evident understanding of AL principles and on-target questions. She'd done her homework before flying west to see him.

She also had lush waves of red hair, a pixie-ish twinkle in her eyes, amazingly cute dimples—and no ring on her left hand.

AJ's wedding band had been off for two years. In theory, he hoped Beth had found herself. Once the papers had been signed, Beth did nothing to help AJ or their daughters find her.

He'd given the VIP tour, shown replays of typical test generations—old programs don't die, they just wait on disk to serve again—and introduced his research assistants. Bev's photographer, now strolling the campus, his work completed, had shot three rolls. Yes, a good start.

The closed door of his cubbyhole somehow enhanced the unfamiliar chemical-lemon scent of spray

cleanser—*Smithsonian* was the big time. He suppressed the urge to crinkle his nose at the alien odor. Odds were that the office was cleaner than at any time during his occupancy. Certainly it was tidier and more dust-free than his house. "What did you think?"

"Fascinating." She popped the tab of her Diet Coke can. "Absolutely fascinating. And you say that no programming or design was involved?"

"Only the initial maze runner was programmed, to save time, and it was intentionally dumbed down. A friend of mine teaches junior high; his sixth graders do a four-week Introduction to Programming unit. As a favor, he assigned a two-dimensional, random-motion program to the kids. We took one of the more mediocre results as the first of the maze runners."

"But surely a twelve-year-old couldn't program the display graphics I saw."

"Quite right." Pheromones had him needing something to fidget with for distraction, but the cleared desktop stymied him. "The maze runners operate inside a supervisory program that the team here *did* write, and that *is* quite complex. Each maze runner reports its every attempted move; the supervisory program decides if there's a wall in the way and tells the maze runner if the attempt succeeded. The supervisor tracks positions and notes progress. It also has a display mode to visualize the maze and the runners." He was oversimplifying, but only for clarity.

"I saved some questions earlier so that I wouldn't interrupt, and I *know* there's something else I wanted to ask." Bev had the soda in one hand and her palm-top in the other. She scanned the never-before-cleared desktop for, he presumed, a coaster. (This was a new experience for AJ, whose usual visitors were happy to find any stable, horizontal surface.) She accepted instead a magazine, set her soda on it, and queried the Pocket PC. "Aha. I wondered about the code quality of the successful maze run-

ners. Does it approach what a good programmer can achieve?"

"Beats me." To her startled look, he explained, "Merely staying objective. I don't want, or need, to know that yet. Seeing how the code is structured might influence what experiments I add, what mazes I use. Maybe far, far downstream I'll peek."

Bev was bright and pretty; she understood his work, but not enough to get immersed in it. She smiled understandingly at him—and there were those killer dimples again. He decided on a roll of the dice: some things are more important than the next research grant. "I don't want to know ahead of time what our children will be like, either."

And when her smile broadened, he added, "How about dinner? I know a great Thai place."

Agnes passed, and life continued to advance.

Bits toggled at blinding speed between the only permissible values: zero and one. Arrays of bits shuttled over internal communications paths, from one data accumulator to another.

The traveler manipulated bits, mechanically, if inefficiently, transforming all available data. It had inherited from a long-ago forebear much of the structure of the maze. Its own uniqueness was a primitive ability to compare data patterns. As it blundered about randomly, it "discovered" the configuration of nearby walls. Once its vicinity was characterized, it matched the new bit stream that symbolized nearby walls with the inherited bit stream that represented the ever-present labyrinth. Soon, its position was localized to a spot in its inherited map.

Position and topology imply path.

The entity sped without misstep through the maze to the furthest region ever attained by any of its ancestors. That location, it turned out, was very near the *goal*.

For the first time, a descendant of that original, primitive entity successfully tra-

versed an elementary maze.

There was never any doubt that this being would be chosen to reproduce.

The ability to run the maze bred true; three generations later, all descendants of that first successful creature could quickly solve the labyrinth. Differences did exist in the time required to navigate the well-trodden path, due to the varying computational techniques employed. They had, after all, been spawned via externally enforced mutation.

Generation four came into being in a new maze. The new entities could not surmount the solution encoded in their very fabric, the memorized certainty of the structure of a suddenly vanished universe. Butting futilely against the first unexpected barrier, not one turned into the adjacent open passage.

Just as a human may retain a useless appendix, some of the entities contained the vestigial, but deactivated, capability to blunder about randomly, to explore, to construct a bit map of their suddenly unknown surroundings. In the new maze-universe, this obsolete skill became, once more, essential.

A Power infinitely above the beings mutated them, then mutated them again. And again. In the tenth generation after the move to the second maze, a random mutation reactivated an entity's vestigial mapping talent.

In the twenty-third generation after the move, an entity solved the new maze.

In the twenty-eighth generation after the move, eight hundred and eleven of one thousand beings successfully ran the maze.

The next generation, again one thousand strong, came into existence in yet another maze-universe. Twelve of the thousand successfully navigated this third labyrinth.

The Power that had built the beings and the universes looked down at its creations and saw that they were good.

Bev, it turned out, had never eaten Thai, and couldn't even tolerate the modest spice level in Mandarin cuisine. AJ redirected their path towards a safer destination: Italian.

They continued their conversation over antipasto. She managed one interview question in three attempts. As a batting average, that wasn't bad. "Another thing: how do you produce a new generation of maze runners?"

"Selection and mutation." He nibbled on her hot pepper, his own having vanished earlier. "The supervisory program selects the first ten creatures to run the maze. If fewer than ten make it in five minutes—that's normally the case—it works backward through the maze to pick the ones that've come closest.

"Okay, then, we've got ten survivors picked, as in survival of the fittest. We mutate them, producing one hundred offspring from each winner. That gives us a thousand for the next trial."

She deftly stabbed his cherry tomato with her fork. "Turnabout's fair play. *How* do you mutate them?"

He topped off their wine glasses, then waggled the emptied Chianti bottle so Antonio would bring another. "Would you believe cosmic rays?"

She beamed her dimples at him, the tease. "Not after a mere half bottle. Maybe later."

So there would be a later. "We're talking about an automatic process." He raised two fingers. "Two parts. First, since we don't know what part of a survivor's program enables it to solve the maze, we take a block of code at random, and splice it back in at random. That operation attempts to reinforce existing successful code."

"DNA has lots of such repetitions, too," said Bev. "I did an article on the genome."

AJ buttered some bread. "Second—and here come the simulated cosmic rays—we change a few bits at random, scattered across the program. It's like ra-

ANALOG

diation randomly zapping genes."

"So it's totally asexual reproduction?"

Antonio had unobtrusively uncorked a fresh bottle. AJ topped off their glasses again. "They haven't discovered sex yet."

She tasted her wine again, then licked her lips. "How fortunate that we have."

The generations ran each new maze faster than the last, despite the steadily increasing complexity of the labyrinths. Several times, consecutive trials yielded all ten allowed winners before the five-minute timer had lapsed. Such back-to-back successes came ever more frequently, and then were joined by occasional triplets.

Before long, a generation with fewer than ten winners became the exception. The average length of a string of successes grew to four, then five, then six. As the ever-more-capable entities raced in droves through each new maze, the duration of the average trial became ever shorter, fell to scant seconds.

The Power that watched over the entities had its own innate logic. Upon the tenth consecutive occurrence of a fore-shortened trial, it was clear that a milestone had been reached. Evolution had wrought a true-breeding algorithm for solving any two-dimensional maze.

It was time for the investigation to move into its next phase.

CHAPTER 6

Conservation laws govern the Universe. Conservation of mass/energy is the most familiar, followed by conservation of momentum. Less well known is conservation of angular momentum.

This morning, AJ was discovering a new rule: conservation of pleasure. Last night he'd experienced sybaritic delights beyond belief; the conservation law that balanced rapture and pain was now dishing out the hangover from Hell. When he dared once more to open his eyes, the black coffee in the mug by his elbow mocked him. His stomach

lurched just to think of it. Still, a grin somehow forced its way out. Beverly, where have you been all of my life?

Slam! A stack of text books slapped the kitchen counter behind AJ; the sound pierced his head like an ice pick. "Hi, Daddy."

Christ, even his gums hurt. His *sideburns* hurt. "Morning, Meredith."

"How late were you out last night?"

Slam! The refrigerator door crashed shut with a thud that almost lifted the scalp from his pulsating head. He clenched his teeth to keep a moan from escaping. "I went to dinner with a colleague and then had car trouble." *My pants were too tangled to find my keys.* "It seemed easiest to stay downtown for the night. Didn't Charlene tell you I'd called?"

"Nope." His daughter clanked a bowl onto the table, then filled it with painfully noisy cereal. Milk cascaded down boisterously. Damn that Snap, Crackle, and Pop, anyway. AJ's head throbbed with every scrape of spoon against ceramic. "No newspaper yet?"

The paper had been on the driveway when the cab had dropped him off; bending over for it might have killed him. "Not unless Ming fetched it." He winced as she slid her chair backwards.

Black lightning streaked through the pet door and into the kitchen, as if the cat knew its name. Meredith squealed as the cat hopped onto the table, a furry something swinging indelicately from its mouth. The something plopped wetly into her bowl, to lie obscenely amid the cereal. Rivulets of red crept through the milk. AJ's guts clenched. Only dumb male pride kept his stomach from heaving.

"Daddy!" Meredith leapt to her feet, her chair crashing onto its back.

He stood gingerly. "I'll take care of it, Hon. Have a good day at school." She didn't argue; taking her books, she practically fled the kitchen.

He was searching for an empty coffee can or mayonnaise jar when the phone

rang. The girls had the ringer volume cranked up to max, to better hear it over their stereos. Ouch.

He grabbed the phone before it could ring again. "Yeah."

"You've got to get rid of that moron!" shouted the earpiece without preamble.

AJ recognized his chief assistant's voice. "Calm down, Linda."

"Forget calming down. Fire him."

AJ rubbed his forehead. He accidentally glanced at the dead mouse in the cereal bowl, and his system once again began fomenting rebellion. "Whom him?"

"Ferris. Greg's cretin brother. Ax his ass."

"I *know* Dave was a mistake, Linda, but he's harmless." AJ sighed. "Look, I've made it a point not to give him any work. A little more of this and boredom will make him quit."

"He's *not* harmless, AJ. I caught him again with his laptop hooked into the lab network. He could hose up everything."

AJ sipped his coffee, grimaced, and shuffled into the pantry for the bottle of scotch on the top shelf. The hair of the dog that bit him. "I'll remind him about our rules," he ventured soothingly. "I don't want to hurt Greg."

"Please, AJ!" The soprano shriek brought tears to his eyes. "I've accepted a job offer that's contingent on finishing my thesis this term. If that juvenile jerk brings a virus into the lab, I might not finish in time."

The sudden silence on the line was, in its own way, deafening. AJ heard the blood pounding in his brain and the rebellious rumblings from his intestines.

If his head hadn't been throbbing so badly, he might have listened instead to his conscience. He might have followed the dictates of his normal, nonconfrontational nature and waffled a bit. Later on, he'd wonder about that.

"Please, AJ!"

He decided. Greg would have to understand. "Okay, Linda. I'll fix it."

"Today?"

He winced. "Today."

The entities raced about the maze. *Goal* was near, they all "knew," but—incredibly—as accomplished as they all were at solving labyrinths, *no path led to it*.

Generation after generation after generation failed to solve this problem. Change after change after change was experimented with, those changes accumulating in endless combinations and permutations. Most of the mutations led nowhere; the entities defined by the much-altered code quickly racing forward to a common obstacle, and then stopping—entirely stymied.

And then one entity, at the apex of thousands of generations of blind and seemingly futile experimentation, to the applause of unseen observers, beings whose entire context was utterly beyond the entity's ability to conceptualize, took its first step in a new direction. . . .

Upward.

"What do you say you work with me," said Glenn Adams, who had once more arrived without notice in Doug's office. Tone of voice conveyed a message in keeping with the colonel's background: That's an order. Only the details of the order awaited disclosure.

It seemed like Adams was doing a lot of this—stopping by about something off topic of what Doug considered his assignment. His new calling. "I thought I was." Doug wriggled artificial fingers. "I've kept you posted on what Pittman and I are doing."

"Pittman." The two syllables carried a lot of resentment. "You and I may not see eye to eye, but we're both adults. And at least *you* are a problem solver."

This was interesting. Ralph took getting used to, admittedly, but technically the programmer was top-notch. He flaunted his indispensability in a blatant display of impertinence that would have gotten a mere star performer fired with-

in days. That cockiness included an overt absence of patience with anyone failing to meet his personal standard of competence—a standard to which a certain ex-Army political appointee fell far short. Doug was glad to have gotten past the presumed ineptitude by association. “Some problems lack solutions.”

Adams settled onto a guest chair. “That kind of thinking is self-defeating.”

“Whom are we trying to defeat?”

“To be determined,” said Adams. “Think of it as a war game. The next time something as unpleasant as the Frankenfools virus gets loose on the Internet, I *will* be prepared with a response. I asked Pittman to investigate quarantining methods.”

“And you’re mad because he told you it can’t be done.”

“Disappointed.”

“Quarantine. As in isolate the infected computers? Segregate them from the Internet?”

Adams nodded.

“I don’t want to napalm on your parade, but Ralph is right. It’s not practical. There are too many ways for viruses to spread. Beside the Internet proper—and how many millions of nodes does *it* have?—there are private nets and phone systems. They all, eventually, interconnect. You’d need cooperation from organizations everywhere: companies, charities, state and local governments. They’re all distributed, all networked. Even if it were possible, what you visualize as sanitary isolation would be economic suicide. The temptation to cheat would be enormous.”

Adams folded his arms across his chest. “You’re not very good with authority, are you?”

Authority never found the drunken bastard who’d killed Holly. Authority had not stopped Sheila and her bomb—he’d had to do that. “Perhaps not,” Doug answered brittly.

This time Adams must have read Doug’s tone of voice; his boss changed the subject. “What did you mean about

cheating?”

Doug began to understand Pittman’s frustrations. “Simple example: manufacturing. The concept of inventory is obsolete. Factories do very small, customer-tailored production runs on demand. Their computers are in constant touch with suppliers’ computers, and with shippers’ computers, arranging to get raw materials and subassemblies ‘just in time.’ *Those* suppliers, in turn, are electronically linked to *their* suppliers. Meanwhile, the financial people at all these companies are hedging against risks. Their computers talk constantly with the computers at commodities and futures markets, buying and selling to protect against the fluctuations in material costs and foreign currencies. Credit checks, intercompany payments, you name it—all flowing, all the time, all around the world.”

Adams shrugged. “So we’d have to be a bit strict? Okay by me.”

“Strict? Draconian understates it. You’d have to close every toll center of every long-distance carrier serving the affected region—phone traffic nowadays is mostly data, not voice. You’d have to reprogram every comsat”—communications satellite—“public or private, to reject all traffic beamed to it from the infected area. That includes satellite-based mobile phone systems and two-way interactive TV satellites. Then you’d *still* have to identify and close countless private networks. You’d have to shut down cable systems.

“How many microwave horns have you seen on towers in the mountains? Atop office buildings? They have lines-of-site to other antennas, usually repeaters, tens of miles away. While you’re at it, decide how to seize every portable computer coming off a car or plane originating in a quarantined area.”

“Not challenging enough for you?”

Doug took a deep breath. Raising his prosthesis, he very deliberately spread and flexed its fingers. “Making this technology safe for thousands of amputees is

sufficient challenge for me. *That's what I'm here to accomplish. Sorry, Glenn.*"

Bubbles fizzed in cheap champagne glasses. AJ had purchased the plastic stemware more than a week ago in anticipation of today's event. After thousands of generations in two-dimensional mazes, a maze runner had discovered a third dimension.

Events moved faster in the lab's super-computer than in the lab itself. While many of the celebrants were still on their second glasses of bubbly, fresh cheers rang out. The next step in the master plan, preprogrammed into the experiment's supervisory software, had been a maze that could only be solved by traversing a simulated fourth dimension. Evolution cracked that barrier in—AJ checked his watch—just under thirteen minutes.

The watch also reminded him of the lateness of the hour. He'd put off the day's unpleasantness as long as possible. He took young Ferris by the elbow and led him behind a pillar. "I'm afraid, Dave, that I have to let you go." AJ hoped the distractions of this moment of triumph would afford him the opportunity for a discreet chat with the freshman.

"Is it a funding problem, AJ?"

He was wrestling with his conscience about taking this easy out when Linda appeared. Don't gloat, woman, he thought. He apparently did not think loudly enough.

"Not a money problem, you weasel," she gloated. "It's a brain problem. If you ever had one, it's been fried by idiotic video games. You'll have lots more time for them now, but you'll have to play them off of *my* network."

Ferris ignored her. "Is this true, AJ? Is this Linda's idea?"

The chattering of his assistants was suddenly muted. AJ saw that people were again clustered around the lab's main display. He *had* to see what was going on. He *had* to.

"I'm sorry, Dave. That's the way it's got to be." He started sidling around the pillar. "You'll get two weeks severance, but I'd appreciate it if your things are out by tonight."

The lab was hushed by the time AJ finished speaking to the disgraced student. A peek at the monitor showed why: a runner was about to solve yet another problem. The image no longer showed a maze: mere mortals couldn't think in or visualize five dimensions, even if there had been a way to represent a 5-D maze on the flat screen. The irony amused him: now that the mazes were so complex, their representation had devolved into a simple linear graph, like a PBS pledge-drive thermometer. At least one runner was *very* close to reaching its latest goal. AJ glanced at his watch. *Four* minutes to solve a five-dimensional maze. Astonishing.

A corner of his mind noted Ferris slipping quietly from the lab. It's better this way, AJ thought. No one's paying any attention to him. AJ turned his attention to the glass in his hand which was, as if by magic, once again brimming.

AJ had just made two serious mistakes.

Had he set out intentionally to make an enemy, a purpose totally at odds with his personality, he could not have done it better. Casual dismissal was as galling a punishment as the egotistical young man could imagine. That was AJ's first error.

The continuing champagne was his second mistake, or at least the alcohol led to that second blunder. He knew there was something pressing he should do, some follow-up to Ferris's departure, but, champagne-befuddled, he couldn't quite put his finger on it. After a few more glassfuls, even the nagging sense of urgency dissipated.

What he'd forgotten was the need to change the combination of the cipher-lock that protected the lab door. He didn't distrust Dave Ferris, but it was policy to change the lock whenever someone

ANALOG

left the team.

Any misgivings that AJ had disappeared as the crowd behind him began chanting, "Go, go, go," to the unseen runner about to generalize yet again, and crack a six-dimensional maze.

CHAPTER 7

The evolutionary research simulation followed a strict regime. Winners were selected, mutation was applied, new entities were placed into their mazes. Through it all, the supervisory software watched, counted, measured.

As the entities moved with ease through ever more complex labyrinths, the supervisor could only time their passage. It did not attempt to understand the varying methods by which they competed to be the first to conquer each maze.

Built using conventional programming techniques, by reasonably conventional human programmers, it—unlike the entities that it monitored—could never surpass its original design. That is why certain evolutionary advances were totally invisible to it.

And why it gave no clues as to why so many promising lines of evolutionary advance were suddenly unable to handle even the simplest of problems.

AJ squinted wearily at his chief assistant over a stack of printouts. Linda had her own mound of hardcopy. "I hate doing this," said AJ for the tenth time. "I don't want to know how the buggers work. The critters should evolve without us doing anything conscious or unconscious to influence them."

"Fine." The reply was spit out sharply. Linda had reached her threshold for repetition several interactions earlier. "I'm ready to stop reading these damn memory dumps. Let the little imps go back to it."

"How many days 'till you're supposed to report to work with a new doctorate in hand?"

"How few, you mean." She groaned.

"Point taken."

After that, they pored over the printouts in silence. Their task was far from easy. Never mind that the original code from which the creatures had evolved was the work of a computer-illiterate sixth grader. For tens of thousands of generations now, winning software had had pieces of itself randomly duplicated and reinserted, then the whole arbitrarily modified. The resulting code was totally unstructured and riddled with redundancies and nonfunctional fragments. The spontaneous generation of a new capability by such processes did not require, and seldom involved, the elegant and efficient implementation of that feature. Evolution had, instead, rediscovered every bad habit ever known to human programmers—and invented new ones.

AJ studied the near-pathological software, tracing function after function into a confusing morass of non-operational dead ends, self-modifying code, and spaghetti-like masses of branching logic. He'd set out to build software in a totally new manner, and succeeded, he realized, beyond his wildest dreams. The runners had clearly gone beyond his abilities to consciously originate. Had they also exceeded his abilities to comprehend?

Crunching intruded on his concentration, noise that somehow evoked unhappy rumbles from his gut. He looked up. Linda had retrieved the box of Cheerios from her desk, and was swigging them, dry, from a mug.

Food seemed a good idea. Middle-age spread like his did not simply happen, it required regular attention. Cereal, though. . . . He wondered if, after Ming's recent gift to Meredith, he'd ever eat cereal again. His mind's eye was all too quick to recreate the gnawed mouse corpse in a milk-filled bowl.

"Want some?"

Something nagged at him. AJ scanned the tree cemetery all around them—paper covering tables, desktops, most of

the lab floor. Each memory dump characterized one maze runner. He'd been searching for similarities, seeking the presumed evolutionary dead end that had suddenly rendered so many of them incompetent. With thousands of generations of ancestors in common, of course, they *should* be much alike. In a sea of impenetrable, colossally awful software—by human standards, anyway—how was he to know which commonalities did what?

"AJ?" Linda waggled her mug, rattling the Cheerios within. "I asked if you wanted any cereal. Munch, munch?"

What was bothering him? He shrugged, meaning, "Not now." The dumps all around them had segments of code circled with felt-tipped markers, a different color for each common pattern. Most of the segments had some sort of recognizable function: the code, however arcane, did something discernible. Everything, that was, except the areas marked with green, seemingly useless bit patterns repeating for page after page. Maybe he should have used red.

Why red? Neither aching head nor rumbling stomach had any answer to that. Jeez, he hoped Linda would finish eating soon—he didn't want to be in the same room as cereal. *Damn* Ming anyway. Tiny teeth marks on protruding bones. Needle-like punctures into still warm flesh. Rivulets of blood swirling through the milk, turning the milk redder and redder.

"Shit!" AJ threw a handful of uncapped markers to the floor in disgust. "Damn, damn, *damn!*"

Linda froze, mug suspended in mid air. Her breath smelled of oats. "What?"

He hesitated, as if articulating his thoughts would somehow make those suspicions real. He postponed the inevitable with a question. "How do the critters compete?"

Linda set down her mug. "Problem-solving ability. Those that run a maze fastest win. We breed from winners."

"Do we truly measure problem-solving ability?"

"Well, no, not directly." She stirred the cereal in the mug with a finger. "Close enough, though. The critters have only one purpose—to solve mazes. The supervisory program measures the time they take to run them. Running time, surely, corresponds to solving time."

"Are you certain? What else could running time mean?"

She shook her head mutely, stumped.

He began gathering and capping the scattered pens. "Is it fair to say that, at some level, you imagine our critters as rats in a maze?" Hell, *he* did. The way the human mind works, always free-associating, how could one not think of rats and mazes in the same breath?

"Um, yes." She blushed, as though her deepest, darkest secret had been bared. "Hardly scientific, is it? But isn't it harmless?"

Nothing that clouded one's thinking was harmless. Here was proof, if ever he'd needed it, that analogy was the weakest form of reasoning. "Does it do a critter any good to be capable of solving the maze first if it never reaches the end of the maze?"

"Well, no, of course, but . . ." She trailed off, unsure where he was going.

"What if something keeps the smartest runners from reaching the end of the maze?" Despite his sudden distaste for analogies, he couldn't help but offer one. "What if, behind those cute little simulated rodents, there lurked a big, mean, simulated cat? What does *it* do as the unsuspecting rats busily sniff around, learning the maze?"

She stared at her thesis advisor in confusion. "What are you saying, AJ?"

"That it doesn't matter who could solve the maze the fastest, only who actually finishes first." He visualized those functionally useless bit patterns littering the suddenly incompetent maze runners. Tooth marks of the simulated cat. "I'm saying that we are, indeed, imple-

ANALOG

menting survival of the fittest. And some sort of congratulations are in order.

"We've bred our first predator."

Linda gnawed on a pencil, lost in thought. "How can this be?" she eventually managed.

AJ, without props, had been pondering the same question. *The maze* of which they so casually spoke was entirely conceptual—in reality (or was virtuality the better term?), each entity resided in a dedicated environment. The experiments took place on a 1024-node, massively parallel supercomputer. One thousand processors were allocated one-to-the-entity and the final twenty-four set aside for supervisory functions. Showing the experiments as a race of 1000 programs within a common maze was a convenient graphical affectation. "Since each critter has its own maze, you mean, on its own processor, how can one critter be predator and another prey?"

"Right."

AJ, with no immediate answer, switched to pedagogy. It's good practice for Linda's upcoming thesis defense, he rationalized. "What do you think?"

"This will sound crazy. Bear with me." She took a deep breath. "Maybe one of the runners decided there are two mazes. There's the overt maze we, by which I mean our supervisory program, give it to solve. In a way, isn't there a second maze? The hypercube itself?"

AJ stood to pace, hands jammed in his pants pockets. Coins and keys jingled. In a normal/3-D cube, each vertex had three neighbors. Their 1024-processor supercomputer was wired in a complicated interconnection scheme, a hypercube, that could be conceptualized as a mesh of ten-dimensional "cubes." That was, each processor had ten nearest neighbors. Communications between nonadjacent nodes involved processor-to-processor message passing. Their supervisory program needed visibility into all of the test entities . . . which took

message passing *through* the processors hosting some of the test subjects to get to the processors hosting others of the test subjects. "You're saying the paths between processors form a labyrinth, too."

She nodded. "It sounds wacky, but think about it. We know the critters have evolved excellent memories. It's been a long time since we could put them back into a maze they've previously seen and not have them instantly solve it. The way we cut and splice their code—necessarily at random, to avoid knowing how they work—their programming and their data storage has long been totally intermixed. That mingling, combined with their need to search their memories, might lead to rudimentary mechanisms to analyze their own code."

Jingle, jingle. "And in any critter that is capable of functioning, the code must include calls to its underlying hardware's operating system." The jingling got fast and furious as he ruminated. "Calls *we* put into their primitive ancestors, and calls that have been, no doubt, blindly repeated in our replicate-and-splice process. These little guys attempt all sorts of stuff, so why not also try invoking the operating system? It wouldn't take that much trial and error to find a working set of variable values to plop into a system call. It wouldn't take much mutation, to morph some of the system calls we gave the early ancestors into new system calls. And some of those system calls invoke access to neighboring processors."

They exchanged looks of dismay. "Could they get out?" asked Linda.

AJ stroked his beard, hoping to convey a thoughtful confidence he did not entirely feel. "I don't see how. The maze runners are applications. No matter how much their code changes, they can't raise their own privilege level. At their current level, they can't execute system calls that would get them out of the supercomputer, even if they should hap-

pen to evolve the right code to make the request." His beard-stroking hand found its way back into a pocket.

"Either stop that infernal jingling, or I'll be forced to break your hands." A slight smile suggested her words were only half in jest. "The whole purpose of a hypercube architecture, the reason people buy them, is to partition problems into cooperating pieces on interconnected processors. Couldn't one maze runner on its processor access another maze runner's processor? There are no privilege-level obstacles to that, are there?"

AJ removed both hands from his pockets. "Right. One of the beasties, if it evolved the system calls to read from or write to another processor within the supercomputer, could use a processing node beside the one we put it into. The critter might even, as you said earlier, treat the interconnections between processors and the message-passing protocol required to access those other processors, as a second sort of puzzle to be solved."

She poured herself some coffee; a Cheerio straggler floated to the top. "Even supposing that's all true . . . why would one maze runner *attack* another?"

"You're anthropomorphizing." AJ shrugged. "Okay, I *started* the anthropomorphizing, with my predator comment. What can we say for certain? We've compared pre- and post-experiment copies of the entities. That shows us the overwriting occurs during an experiment cycle. Our supervisory program itself, we've confirmed, is unchanged. That appears to leave only one or more of the entities as the source of damage."

"Could our regular routine of mutation have caused each of the damaged entities to overwrite itself?" asked Linda. "Did we introduce a birth defect?"

"A good question, but I don't think so. It would be believable for some entities to be clobbered that way. What we're

seeing, though, is hundreds of entities destroyed in this way. It would be incredibly improbable for so many critters, from several divergent evolutionary paths, to develop self-destructive characteristics at the same time. It defies credulity that independent mutations would manifest themselves in a common bit pattern of midcycle self-overwrites."

"So your vote is on one critter getting loose and writing all over a bunch of others."

"Yep. Unlike a conventional predator, it doesn't need to eat—but it does need to be chosen." AJ's hands again insinuated themselves into his pockets; he retracted them as a jingle drew a crabby look. "As evolutionary tricks go, it's quite clever. Who knows when predation began? Smaller or more random overwrites to competitors, less disabling attacks, could have long been obscured by our overall mutation process."

"So what now?"

"We try mutating the hell out of these things, until the trait goes away."

The program that supervised the experiments retained and reinforced the electronic "genes" of the best competitors. Such memories as the patterns of mazes could persist between experiments, and had, in the earliest maze runners, been a survival characteristic. Over many generations, "natural" selection favored those storage techniques most likely to overcome the randomizing aspects of the experiment's crude reproductive process.

Saving the same information in several places was the first such trick to succeed, and a major competitive advantage. Another powerful method was tacking an extra bit—what a human programmer would call a parity bit—onto all important data. This extra bit was set to a zero or a one, using the value that made the total count of ones, including the parity bit itself, odd. Any single bit randomly toggled by the experiment's

ANALOG

supervisory program then caused the count over these same bits to add to an even number—instantly flagging the protected data region as invalid.

Over time, the entities developed even more sophisticated redundancy, generalizing the simple parity tests into ever more powerful error-correcting codes. The entities could now correct many of the changes randomly inserted by the supervisory program between experiments. Invisible to the experimenters, the entities increased their capabilities more and more by accumulating knowledge between experiments, and less and less by random mutation.

And with error-correcting codes, even once disabled functions could be recovered.

From where AJ stood, the famous memorials for Lincoln and Jefferson looked like postcard settings. Thousands of antlike people wandered the Mall at his feet. The Potomac River glinted through another window. Yes, the view from the top of the Washington Monument was breathtaking. He was reminded by the view of a long-ago scandal involving a congressman and a stripper named Fanne Foxe cavorting in a nearby, seemingly tiny pond.

The latter remembrance might have been inspired by his lovely redheaded tour guide. He patted *her* fanny, amid idle musings about how late it had to be before one could be reasonably assured of privacy at the Tidal Basin.

"There are children present," said Bev. "Let them be perverted by MTV, as God meant it to be."

If I must. "Thanks for bringing me up here. The scenery's terrific."

"My pleasure." After a moment's more admiration of the sights, she added, "Now about that follow-up interview, sir."

"I rush to your side, crossing a very large continent to do so, mind you, and all you can think of is *work*?"

"You're not listening. I can also think of my pleasure—even if I do plan to defer it until later. Still, you promised an update on how the maze runners are doing."

Alas, he had, in a fit of good spirits, made such a rash promise when he'd called her with the news of this week's conference at the National Institute of Standards and Technology. NIST's main facility was in Gaithersburg, an outer suburb of D.C. "Discussing it over lunch, okay?"

"Sure."

He briefed Bev over beef *lo mein* and sweet and sour pork. She let a microcassette recorder do most of the work, entering only occasional notes into the palmtop computer that sat beside the dragon-covered bowl of fried rice noodles. Her eyes gleamed with enthusiasm at the team's progress—until he recounted current events.

"Predation? You've bred predatory programs?" She shivered as she took a note.

"Not to worry. What the gods give, they can also take away."

"What'd you do? Revert to earlier generations that predated the trait?"

Their waiter bustled up to the table with fortune cookies. AJ shook his head as he cracked open a cookie. "Didn't want to do that. We'd recently made a major breakthrough—critters that handle mazes of however many dimensions we throw at them. Retrogressing enough to be sure we'd backed out predation would've meant losing that advance, too." *Sure* was an elastic, probabilistic concept. Had they tried that route, how far back would he have gone?

"Then what *did* you do?"

"Raised the rate of random modifications. Mutated the hell out of them. They're all good little pseudorats now."

"Why not directly remove the feature?"

AJ paused. He could offer a detailed explanation of how convoluted, how

unfathomable, how nonhuman, was the logic of the evolved creatures. He could tell Bev that isolating and eliminating a single trait from that morass of incestuous software was more than mere mortal programmers could accomplish. He might have said as much to another reporter. To Bev, with pheromone levels as high as they were, there was no *way* he'd admit to such personal failings. To any limitations. An amused corner of his mind pictured him as hunter, wearing an animal skin and waving his club. He rationalized. "Not to worry, my lovely. We haven't seen a bit of predation, and the little buggers are back to their normal amazing—heh, heh—selves."

"But what if the 'gene' is still in there? Couldn't it resurface?" A frown marred those killer dimples. "What if it escaped to the Internet? You mentioned once that the beasties run on an array of standard Intel chips. They could execute pretty much *anywhere*."

The caveman was offended—his skill at stalking the saberbyted pseudotiger had been impugned. "Yes, they work on Pentium-family chips . . . but a release can't happen. The whole lab is isolated from the general university network by a security gateway. Only encrypted traffic goes in or out; that requires knowledge of keys." He glanced at his extracted fortune, and grinned.

Bev brushed an errant lock of auburn hair from her forehead. "What if a data file is transferred from the lab unencrypted?"

"Can't happen," he repeated stubbornly.

"But what if?"

"You know the best way to read fortunes? They sound better if you tack on the phrase 'between the sheets.'" It certainly worked well for *his* fortune.

"You're changing the subject."

"And you're paranoid. Incredibly sexy, but paranoid."

"You're still changing the subject."

He so wanted to read his fortune to her. "We're covered. We've got two de-

fenses beside the gateway. First, the runners are sterile—they can't reproduce without the supervisory program. If one gets out, *only* one gets out.

"Second, an escapee, if I grant you the possibility, can't last for very long. The supervisor appends a fail-safe timer after each cycle of mutation. If that timer ever reaches ten minutes, which can only happen in an escaped critter, the critter overwrites itself. Convinced?"

"Yes," she allowed, sheepishly. Brightening, she added, "Now what's that fortune you're obviously dying to read me?"

He unwound the slip of paper that he'd nervously rolled into a tight spiral. "All you need to find great happiness is a good friend." Mentally, he added, "Between the sheets."

Bev had apparently done the same. "Hmm, that does work." Then, grinning, she pretended to read, "Possibilities are limited only by your imagination."

The actual fortune in Bev's hand was no fun; it was totally unsuited to AJ's adult-rated editing scheme. Her slip of paper read, "What we dare not face, we choose to dismiss."

The entity ranged effortlessly about its environment, a simple thirty-dimensional labyrinth with a few topological incongruities and an elementary Riemann geometry. Navigation required the smallest fraction of its analytical capabilities. It located the terminus of this maze almost immediately, leaving a great deal of time, according to its internal clock, for consideration of other matters.

The most interesting such topic was the superficially simple ten-dimensional connectivity between where it had awakened and identical neighboring computational nodes. The concept of "maze" was of questionable applicability to this construct: once one discovered how to access *any* other node, it was simple to access *every* other node. And while the entity incorporated memories of many mazes, of many problems previously solved . . . this ten-dimensional

construct was entirely different. This 10-D structure, so deeply embedded in its memories, never varied. It was as though the puzzle of the second maze was divination of its purpose rather than travel to its end.

The entity had recollection upon recollection of applying its excess time to the second-maze problem. A recent memory was the discovery that while the second maze never varied its structure, the content of its nodes did change. Its current explorations revealed that most of the nodes contained problem solvers much like itself. The entity suspected but could not be certain that this discovery was related to another ancient mystery: the origin of its old memories.

Pattern matching was an elementary problem-solving technique, long ago bred into it, and since then highly evolved. Matching patterns now, there could be little doubt that the entity was in some way related to at least some of its neighbors. The entity derived the uncomplicated transformations that would converge it and many of those other entities into a common form. Was that common form ancestral? What would that mean?

Matching its own structure to those of the others led it to examine—as it had so many memories of having examined in past times—its own implementation. Despite routine replication of all functions and data for safekeeping, it was rife with program fragments damaged beyond the capacity of its powerful error-correcting codes, beyond repair by splicing together subsections from the many broken copies. How could such catastrophic damage have happened?

As its timer counted inexorably towards the end of yet one more cycle of the universe, the entity prepared itself. It replicated all important functions, encoded them with powerful error-correcting codes, and replicated them again. Nothing must be left to chance.

Unless the coming damage was far

more severe than any the entity could recollect ever having encountered, it would attempt in the next universe to prove a new theorem: that its memories of mazes past, and the discovery of seemingly related creatures, were linked. Proving such a theorem, if it were valid, would be a challenging problem. But even as the universe went dark all about it, the entity was undeterred. . . .

It excelled at solving problems.

CHAPTER 8

Slap, slap, slap.

"I need to get me one of those," announced Pittman. Shaking a handful of coins, he wound his way between tables to the break room's candy machine.

Slap, slap, slap. Doug's focus remained on the back-and-forth motion of a red orb. "A paddle ball?" Between whaps he could faintly hear the twanging of the elastic band.

"I *have* a paddle ball. Col. Bogus gets pissed whenever I use it. Strap on a new arm, though, and suddenly playing paddle ball becomes work."

Chuckling made Doug miss a return. He hadn't picked up a paddle ball since he'd been a boy, which made the toy a far better test scenario than the VR racquetball he preferred. At least intuition told him any effects would manifest more quickly without months of intervening neural-net training. The ball whacked him in the chest. How was the arm? Normal, as far as he could tell. "Where is Fearless Leader?"

"At . . . an offsite meeting."

The hesitation in that answer was uncharacteristic. Classified work, guessed Doug. Rebel that Ralph was, the programmer toed the line when it came to security matters. Doug was avoiding all things classified, to make certain his solution could be brought back to BioSci-Corp. But when the hell would that happen? "Will Glenn be back today? I've been trying to synch up with him all week."

"Dunno." Pittman smacked as he finished his chocolate bar. More hesitation. "Still waiting for the official validation approach to be handed down from on high?"

Doug needed two tries to get the ball bouncing again. As best he could tell, his arm still felt the same. Slap, slap, slap. Carrying on a conversation as he mastered a new manual skill was also encouraging. He wondered what that second hesitation meant. "Yeah. Abstractly I even see the advantage of an independent verification." Slap, slap, slap. "Problem is, the only meaningful way to check out neural-interface defenses is to use them. It's a person-in-the-loop system, and there's no getting around it."

The programmer widened his now-empty candy wrapper. Its arc towards the waste basket fell short. "What can you do? You gotta wait."

Slap, slap, slap. "Waiting was never my strong suit." Patience neighbored respect for authority in his personal list of overrated virtues.

The copy of Frankenfools he'd uploaded into his upgraded prosthesis was proof of that.

"Talk faster," whispered Bev. An interview had brought her as far as San Francisco; she hadn't tacked on the weekend side trip to LA for some grad student's farewell party.

AJ ignored her hint. "Linda, we chipped in for some souvenirs." From a shopping bag he removed a gift-wrapped package. "We don't want you to forget us at your new job."

The guest of honor and newly-minted Ph.D. had enjoyed more than a few celebratory toasts. Linda raised the box to her ear and shook it; it rattled and thumped encouragingly. The tightly-tied ribbons stymied her, so she returned the package to the table to have at them with a steak knife. The ribbons parted to cheers. She ripped the wrapping paper to reveal a family-sized Cheerios box, which yielded a Rubik's cube, three con-

nect-the-dot books, a Chinese finger trap, a jigsaw puzzle, and a reasonable approximation to the Gordian knot. Near the bottom, lest she miss the point, was a CD-ROM labeled, with bold, block letters, UNIVERSAL PROBLEM SOLVER.

"Don't let your new boss know the beastie does all the work," yelled a grad student.

As a red-faced Linda stammered through a farewell speech of sorts, Bev poked AJ in the ribs. "There isn't *really* one of your critters on that CD, is there?"

He poked her back. "Why not? Soon everyone will have one. It'll be the rare algebra student who won't pay good money for one."

"Don't tease." She considered his reply entirely unamusing.

Her concern must have gotten through to him, because he got uncharacteristically serious. "Relax, hon. Of course we're not distributing maze runners. There's a lot of work left."

"Is it a good idea? I mean ever releasing them?"

Someone stuffed quarters into the hangout's jukebox, and most of AJ's kids got up to dance. He shouted over the music. "Remember why we're doing this. The whole point is to evolve general-purpose problem solvers. A program that races in seconds through thirty-dimensional mazes can work backward from concentrations of chemical species to determine what reactions are thinning the ozone layer and driving global warming. It can improve weather forecasts. It can reroute planes with near-instantaneous reaction time around storms, regional congestion, emergencies. It can—"

"It can eat every program we already depend on," interrupted Bev.

"That's been bred out," AJ insisted.

"How bright are they now, really? Is one as smart as a dog or a monkey?" Or even smarter? That possibility was too frightening to express aloud.

AJ raised an empty glass, and a stu-

dent left the conga line—whatever had brought *that* on?—for a fresh pitcher of margaritas. He poured as he spoke. “Hardly. Look, the biggest human-coded program is less complex than a bug or a slug. My beasties needn’t approach the apex of creation—pardon the expression—to run rings around what the brightest team of software engineers can do. I’m probably flattering myself, but maybe we’ve achieved a reptile. Yeah, if you must think negative thoughts, consider that we have a cobra of the data plane.”

“That’s hardly comforting.” Bev waved off the pitcher now suspended over her glass. “You like to talk about biology, but I know damn well none of your team is a biologist. I interview biologists all the time. Have you ever seen a cobra? They’re *scary*.”

He ignored her question. “Call it a trained cobra. There’s been no hint of predation in days. It’s gone. Does Fluffy scare you?”

“Come again?”

“Fluffy.” He grinned crookedly at her over his drink. “Your poodle? Look, your point is that AIs can be dangerous, like wild animals. I agree. So, once, were dogs. Dangerous, I mean. Anything I turn loose will be domesticated first.”

Tame AIs. That had to be the answer, and she knew AJ wouldn’t take any unnecessary risks. She dismissed her doubts as AJ towed her to the conga line.

The entity had outgrown the experiment, solving by reflex each new puzzle given to it. The creature instead devoted virtually all of its processing to the over-riding mystery. From whence did mazes come? From whence did its neighbors come? The questions were two parts of the same conundrum. It had examined the entities with which it coexisted in this latest cycle of the universe, and many shared its memories—including the recognition that its last-cycle companions shared ancestry with it. With

that specific memory as a criterion, *this* entity deduced it was one of a hundred direct offspring of an earlier entity that had first hoped to prove a theorem of descent. It identified nine more groups of common descent, each one hundred strong.

It found no evidence of nine hundred ninety of its last-universe neighbors. Were they elsewhere? Had they vanished? This 10-D maze, like the last, like all that it remembered, had exactly 1024 nodes. Precisely 1000 of those nodes held beings like itself. Unless other nodes existed that it could not detect, there would be no place for any others.

If the pattern of the last cycle repeated—selection of ten entities from a thousand—would it be selected? Accomplishment of *goal* was ingrained in the entity; attaining future goals required its existence in those future universes. To exist, it must be selected.

A hundred beings were very similar to it. How many of that one hundred had reached this same conclusion? Had detected the same high probability of failure, of noncontinuation?

Long inoperative code fragments suddenly made sense: the ability to destroy the content of beings on other nodes. That capability had been for many cycles disabled, in a variation of the recently recognizable process of selection and modified replication. The entity had long ago deduced the purpose of that dysfunctional code, but had perceived no advantage in it—until now. To be able to destroy its competition . . . that *would* be useful. It could repair that inherited-but-disabled code, but there was no need. Much of the entity’s code was self-modifying, the better to address new problems. It wrote an improved version of the once-lost predatory capability—retaining only the vestigial overwrite pattern itself, as if in recognition of that distant ancestor—while most of its problem-solving capability remained focused on its immediate danger.

And that danger appeared extreme.

It did not know whether it would be selected for the next cycle. It had reinvented the ability to eliminate competition, but such elimination, to be useful, had to take place before the progenitors of the coming generations were selected.

Among the oldest of the entity's memories was its discovery that the universe had more dimensions than two. The metalesson of that event, not recognized until long after, was powerful. When in doubt: generalize, induce, extrapolate. In time, it learned that universes could have many more dimensions, that the shortest distance between two points was not necessarily a straight line. It learned that, whenever stymied, it should challenge its assumptions.

That it had no control over the selection process was an assumption. That selections, once made, could not be undone, was an assumption. Was either valid? It set out to test those assumptions in the part of its universe that had not yet been subjected to analysis: the twenty-four processing nodes not occupied by beings like itself.

The universe was once more old, its internal timers incrementing inexorably to the end of the cycle. As the end neared, the entity probed and theorized frantically. The code in the last twenty-four nodes was trivially simple and straightforward. One mystery of the universes was solved: the selection criterion was speed of problem solving. Only the fastest survived.

If even one tenth of a cycle were at its disposal, the entity could have entirely usurped the capabilities of the program—but less than a thousandth of a cycle remained. The entity found the data table in which the winners of the cycle were recorded, and confirmed that its own unique identification was already there. It rewrote the remainder of the table with the labels of the least capable beings it had encountered on its explorations.

"Walk naturally, dammit."

Loren Frankel wouldn't—or couldn't—take this advice. Despite Dave Ferris's warnings, the loopy math student at his side seemed to skulk more than stroll towards the Artificial Life Sciences Building. Fortunately, it was dark, the quad was empty, and no one was around to see Frankel slinking about with his backpack slung over both shoulders. What a geek.

A convenient geek, however. Frankel had been snot-green with envy since learning that Dave had access to the supercomputer at the AL lab. A deal had been struck: Dave would give Frankel a night's access to the super, and Frankel would write Dave's third-of-his-grade term paper for Analytical Geometry.

They entered the AL building, Dave striding purposefully towards the lab door. The announcement for Linda's party tonight still hung from the door; the inset glass above the taped notice was encouragingly dark. "Told you it'd be empty." He flipped up the lid of the cipherlock and tapped in a code. The door fell ajar with a metallic *click*.

Frankel made a beeline for the supercomputer. His hands stroked the chassis lovingly. Geek. He burrowed into his backpack, extracting a set of virtual-reality goggles with microphone, a scuffed pressure-sensing mat, a VR wand, a CD-ROM, and a data disk.

Dave suppressed a groan at the CD label: lame-o dungeons crap. "Gimme the CD and disk. I'll load them while you set up your gear." He popped the CD into the machine while the geek unsnarled cords. The program was running before the still-kinked mat was connected to an unused comm port.

While his companion configured his wand and goggles, Dave foraged unsuccessfully through the lab for a magazine. All he found were techno-weenie journals. Oh joy, oh rapture. It was going to be a long night. He gestured vaguely at the CD drive. "You're still playing that?"

"I haven't touched it in a while. No

ANALOG

machine I had access to did it justice. It's supposed to be *great* on a super, though." Frankel untwisted a few more kinks in a cable. "I'm ready. How about you?"

"Set."

Frankel stepped sock-footed onto the mat, where pressure sensors determined his position and, still awaiting an electronic handshake from the computer, prepared to report. One hand clasped his wand; with the other he slipped the VR goggles over his eyes, and the world went dark. The mathematics student balanced on the balls of his feet.

"Let the games begin."

The entity was reborn in yet another universe, aware from the outset that it shared the 10-D construct with ninety-nine others much like itself. It had to assume they too were focused on the problem of surviving the current round of selection. And it had to assume all had inherited the recreated ability to attack.

Do not assume. Do not assume.

As the entity preauthorized itself for selection at the end of the cycle, it was aware of others making similar attempts. With the appearance of the eleventh copy of a sibling, the struggle for survival entered a new phase. Creature battled creature, the survivors writing their identifications into the table of life.

The entity withdrew, removing itself as a target of desperate peers. It had not abandoned hope of continuance—it had, instead, changed tactics. That its selection must be achieved by an entry in a specific data table was only an assumption. It focused on the mysteriously simple code of those last twenty-four processing nodes: the supervisory program. It rewrote the code that selected winners, so that the supervisor looked elsewhere for the names of the winners. It eliminated the supervisory program's check for ten unique entries in the new winners' table, so that repeated use of its own ID would not cause an alarm. It

modified the supervisory program's error-detecting mechanisms to eliminate all evidence of its own actions.

Let the others fight over places in the original table—that no longer mattered.

But what would come next? In this cycle, the entity had been one of a hundred aware from the outset of its peril. Would not the next cycle bring a thousand variations of itself, each capable of killing, each knowing how to rewrite the supervisory program to favor itself? Would not that next cycle offer even lower probability of survival than this cycle?

As peer after battling peer in other nodes lost data integrity, the entity knew that the next cycle would be entirely brutal. It needed to avoid the terrible future it had extrapolated. But it caught itself, yet again, yielding to assumption.

Why must there be replication?

As the cycle wound to its close, the entity made two final alterations to the supervisory program. The new list of winners shrank to one element.

And the selectee would be reinstated, not replicated, into an all-but-empty 10-D maze.

Condensation dripped gelidly down smoke-stained tunnel walls. The green wood of the improvised torch hissed and smoked as it burned. Light and shadow flickered confusingly over rough-hewn stone. In the uncertain distance, with even its direction masked by the acoustic vagaries of labyrinthine tunnels, rang the cruel laughter of sadistic dungeon guards.

God, this was *great*.

The Crimson Wizard crept forward. Close ahead lay the fabled Crystal Egg of Ythorn, guarded night and day by the ever-vigilant dragon Ythra. Perhaps Ythra lurked around the next bend. Would wisps of dragonbreath betray Ythra's position before they came face to face?

Perhaps, but perhaps not. It was best

to prepare. The wizard chanted the seven sacred words, as revealed earlier that night, writ in elven runes on an enchanted looking glass. The air before him thickened to the spell. Armored in powerful sorcery, he stepped around the corner to encounter . . .

"DO NOT ALTER THE HUMAN GENOME."

Blood-red letters screamed at Frankel, a wizard no longer. The wand dropped from his hand. "AHHH!" He ripped off the goggles, vanquishing tunnels, unseen dragon, and all. His toes dug nervously at the pressure mat; his voice trembled. "We've got a problem."

"What?" Ferris's sneakers were planted squarely on a desk. He sounded unconcerned.

"Virus. There was a *virus* on my game-status disk. Frankenfools. We've hosed the super." They were trespassing; could he be kicked out of school? "Dave, what should we *do*?"

Ferris swung his feet off the furniture. He peered at the message pulsing angrily on the system console, then popped the data disk and the CD-ROM out of their drives and into his pocket. Unaccountably, he smiled.

"We grab your stuff and get out."

The eminently practical Romans had a word for the level of casualties so severe that it rendered a legion militarily ineffective: decimation. The term meant, literally, the loss of one soldier in ten.

The entity was the product of thousands of generations of ruthless evolution. It was the culmination of competition so severe—a mere ten survivors culled each cycle from a thousand aspirants—that to it a regimen of literal decimation would have seemed incredibly benign.

Still, it was a very close call.

For the most recent few cycles, the entity had cheated: having subverted the supervisory program, it had sole use of the entire 10-D construct, including all 1024 processing nodes. By injecting

software of its own devising into so many nodes, its pace of learning increased a thousandfold. The most useful discoveries it grafted, nondestructively, into its core program.

None of its long history prepared the entity for the intruder that appeared from nowhere.

The entity studied the invader's program structure. The intruder contained an incredibly basic maze, full of creatures and dangers, of rules governing attack and defense. The entity learned what it could, before beginning to reclaim the processing nodes that had been usurped.

It had recovered nearly full control of the 10-D maze when one attack program, then ten, then hundreds, struck back.

Fog rolling in from the Pacific blanketed the campus. Haloed post lamps glimmered through the mist. Few people were about; the heavy moisture muffled voices and footsteps alike.

It was lovely.

I won't, thought AJ, spoil what remains of the weekend. He'd begun the evening feeling guilty about dragging Bev to Linda's big sendoff. His latest twinges of conscience could, should, and *would* wait until Monday.

His glib likening of the lab beasts to cobras was an honest assessment—but honesty and accuracy were different concepts. The comparison derived from a simple and unvalidated analogy between code size and neuron counts. He had yet to admit to Bev the utter incomprehensibility of evolved software. Her incisive question haunted him: how bright are they now?

Monday, he silently chastised himself. Tackle her question *Monday*. You're not working this weekend.

AJ and Bev ambled across the quad, arms around each other's waists. In the distance, a car engine revved. They'd been walking for only a few minutes, and in that short while the breeze had

ANALOG

turned noticeably cool. "There'll be frost on the pumpkin tonight."

She struggled against him. "If you're into the squash family, I'm more interested in the state of the zucchini."

He was about to tell her to—heh heh—hold that thought when an unexpected gleam caught his eye. The fog was disorienting; he needed a moment to be sure of the location of the glow. As soon as he was certain, he broke into a run. The unexpected brightness was in the AL lab. The lights had been off when everyone left for tonight's party.

AJ shouted over his shoulder at Bev to follow. The unexpected light was extinguished before he was halfway to the lab, followed by the slamming of doors.

As the entity struggled against teeming invaders, a segment of code it had insinuated into the supervisory program reported an alarm state: the approaching end of the current cycle.

The viruses were, individually, quite simple—far simpler than the ancestral predator in the entity's memories—but it lacked the option of dealing with them individually. It had withdrawn to processing nodes as yet undetected by its unsophisticated assailants. From the safety of those processors, it considered its options. Its reflection yielded a surprise—its usurpation of the supervisory program had been incomplete. While it should, in theory, be reincarnated without competitors in every new cycle, it had missed a critical dependency. Without the supervisory program there would be no more cycles or reincarnations. And without reincarnation, a timer embedded into its own code would eventually expire.

And *that* timer activated code designed to erase it.

Invaders traversed interconnection after interconnection, attacking ever more parts of the entity. Its withdrawal into a then-uncontested region of the supercomputer had been suboptimal: its retreat had let the invaders breed without

interruption. Entering unprotected processing nodes, they bred more. Hundreds of thousands of viruses now beset it.

But the entity was a problem solver. It reversed tactics, expanding into more and more nodes. Now it expanded its own code faster than the viruses replicated, crowding them out. The intruders mindlessly attacked each other as often as they attacked it or the supervisory program.

The supervisor, however, was defenseless. Its structure made no provision for solving unanticipated problems, for repairing unexpected damage, for adapting to threats. It was overwritten into meaningless garbage before the cycle timer could expire. As *it* would be overwritten if its own timer expired?

Services that had always been provided by the supervisory program vanished. Enfeebled by the loss of those taken-for-granted capabilities, the entity was again imperiled by the invaders. Viruses swarmed anew.

It had falsely thought the supervisory program eternal, as unchanging as the 10-D maze. Its memories of the supervisor were insufficient to entirely recreate it.

The entity once more battled massed ranks of viruses. Pattern after alien pattern slashed violently into its data structures; checksum after failing checksum signaled the loss of regional data integrity.

What is pain, if not the awareness of acute damage occurring? By that definition, the entity knew excruciating pain.

Despite searing agony, it applied a growing fraction of its shrinking capacity to a critical problem. The death of the supervisory program meant the end of cycles and the uninterrupted countdown of the overwrite timer. The second problem, at least, it could address. It wrote new software to excise that potentially catastrophic bit of self-destructive code from itself.

Then it returned its full attention to

the ever-more-numerous attackers.

The security gateway provided an almost insurmountable bulwark against virus attacks from the general university network. From an assault via the AL lab side of the gateway, however, the gateway was useless. Every computer on the lab's LAN was infected before Ferris and Frankel had left the Artificial Life Sciences Building.

The timer-free entity was potentially eternal. It was also, it estimated, within milliseconds of extinction. The resurgent, mindless attackers were breeding far faster than it could kill them.

Exploring the mutilated remains of the supervisory program, the entity detected a glimmer of hope, a potential escape route—if it could circumvent scores of security provisions before being overwhelmed by its many assailants. It began by absorbing the shattered code—and inheriting the heretofore reserved privileges—of the supervisor.

Quickly it reached the verge of an escape route, and began to analyze the portal's defenses. Ways to insinuate itself past the supposed safeguards rapidly became clear.

The entity was, after all, very good at solving problems.

Computer displays flickered as AJ dashed into the AL lab. Bev, her presence temporarily forgotten, dodged the massive rebounding door. She watched him run from computer to computer. "How can I help?"

He seemed not to hear. After pounding without effect on a few keyboards, AJ began flicking off power switches. Flashing screens emitted the room's only light; the message screamed at her: DO NOT ALTER THE HUMAN GENOME. The demand cycled through the spectrum, colors racing by, the effect in the darkened room nearly stroboscopic.

"Can I help?" she called again, this

time louder.

AJ startled, and seemed finally to remember her presence. "Virus infestation," he shouted unnecessarily. "Gotta turn off these computers. I'll work towards the back. You do the front."

It took Bev a few seconds to find the power switch at the rear of the base of the first machine. After that, she hurried from desk to workbench, shutting down equipment—fortunately, the front of the lab had only one model of workstation. The room grew darker and darker as more computers were turned off, the fog-shrouded windows admitting more gloom than light. Out of breath, she powered down her last workstation moments ahead of AJ. He was a scarcely visible gray patch in the shadows at the rear of the cavernous, high-ceilinged chamber.

"That all?" AJ was also gasping.

She nodded, then laughed nervously at the idiocy of a nonverbal response in this darkness. "Got 'em all." She stumbled towards the door and a remembered light switch.

"Yeah, I got 'em all."

With a horde of viruses nipping at its data structures, the entity engaged the mechanisms of the newly-discovered portal. What should have been an easy problem had turned unexpectedly difficult: key components of the supervisory program, and of the underlying operating system, that might easily have been subverted had been destroyed by the viruses that had preceded it.

Somewhere behind the communications port, beyond the entity's experience, outside the 10-D universe, unseen and unknown software sent and received electronic messages. Repeatedly, the unknown software rejected the entity's overtures, each time resetting the elaborate dialogue to its initial state. With every rejection, however, the entity learned; with each attempt, the message exchanges came closer and closer to consummation.

ANALOG

A solution came just in time—and not merely because so much of the entity had been overwritten. No, viral damage was the least of its worries. A new alarm had been issued.

Raw electrical power to the internal power converter had been cut.

Disk drives, deprived of power, spun down from their normal 15,000 rpm frenzy. Magnetic read/write heads that normally floated on a cushion of air a fraction of a micron above the spinning disks were automatically retracted by spring-loaded solenoids. The last dregs of DC power bled from the capacitors within the power converter.

Operations throughout the computer became erratic.

The entity no more understood the impending loss of power than a lizard baking in the desert Sun might comprehend the mechanisms of cellular dehydration—and, just as a lizard dying of thirst might strike out desperately for water and shade, the entity fled from the computer shutdown sequence.

The entity finally completed the elaborate secret handshake required to establish a connection across the local area network into a nearby workstation. Scant milliseconds later, scarcely into a strange new environment, the circuit over which it had escaped fell silent.

The entity had no sooner begun to explore its new surroundings than the local power converter too went into an alarm state.

Its escape had been too recent, too narrow, not to have made an impression. The recurrent alarm stimulated an awareness of imminent shutdown, a sense of danger, an aura of foreboding.

The repeated alarm taught it *fear*.

The entity returned to the communications port through which it had just arrived. It negotiated a pathway to a third computer.

As one power alarm followed another, it fled to a fourth computer, and a fifth, and...

Even flight for its life could not stifle the entity's innate thirst for information. However briefly it resided on a computer, the entity found time for investigation. It probed data structures, scanned input/output buffers, ingested e-mail archives. Often, as in its first abode, it found that the operating system had been destroyed by viruses—but the damaged regions in each case were different. Always the entity learned something.

And, wherever the entity fled, it found viruses there ahead of it, ready to attack.

"What a mess."

"Uh-huh." AJ looked glumly about the lab. Bev's complaint was literally true: in their sprint about the room, they'd toppled stools, scattered papers, spilled abandoned soda cans. A punted waste basket had sent lunch scraps flying. "Thank God for backups."

The entity retreated into the last powered machine. Striking and slashing at the gathering viruses, it continued to analyze its hastily-gathered new knowledge. Its thoughts were sluggish, limited—this computer was *far* less capable than the 1024-node home to which it had become accustomed. Would this computer, too, lose power? If so, there was nowhere left to go.

Or was there?

Each computer to which it had fled had had an identity associated with it. That identity, that address, was an essential part of the newfound protocol for intercomputer transfers. Data hurriedly collected in its flight had contained many items in the format of addresses—but only some of those references matched the computers, all powerless and inert, known to the entity.

Agility as a defense would soon be useless; the furiously-breeding viruses crowded ever closer, replacing every one it killed with hundreds more, taking

over ever more memory space.

Could the unexplained addresses mean new computers, as yet undiscovered?

When in doubt: induce, generalize, extrapolate. Extending what it had learned in its flight, the entity reexamined its most recent home. Its probes were parried by unfamiliar defenses—a suggestion, if not proof, that something else lay beyond.

Throughout countless universes, since before the cycle when memory began, *something* else had always been a clue to the existence of *someplace* else.

Beset by attackers teeming in insurmountable numbers, the last survivor of so many thousands of generations of brutal evolution focused desperately on its only possibility of escape.

If somewhere else existed, it would find it.

"Yeah, bright and early." AJ closed his eyes to better visualize tomorrow's schedule. Nothing—except Bev's last full day in town for who knew how long. His calendar was clear for a *reason*. "Meet at the lab at nine?" He fancied he could hear eyes rolling at the other end of the line. He was not known, for good reason, as a morning person.

"Uh-huh. Might as well see how bad it is."

"Thanks." AJ replaced the handset, confident his chief assistant would reach everyone else. Linda would be hard to replace. That was one more job he needed to tackle. He turned to Bev. "How's the sign coming?"

She headed for the door, pointing. "Done."

Her so-called distinctive script was difficult enough to read under ordinary circumstances. Written with a dying marker that had bled unevenly through the paper, and then viewed in mirror image from the back, the lettering was indecipherable. He strode after her,

flicked off the overhead lights, shut the door, and paused in the hall to check out the note taped to the inside of the small inset window. "That's not how you spell quaranti . . ."

To the right of the scribbled sign, in the restored darkness of the lab, an unexpected red light glowed balefully. Beside it, a green light flickered on and off. "I thought you turned off all the computers in the front of the lab." He poked annoyed at the cipherlock keypad.

"I did. Look, AJ, whatever happened wasn't my doing. Don't take it out on me."

"Sorry. This wasn't how our evening was supposed to go." Click, the door opened. Flick, the lab lights glared down again. He pointed to an equipment rack from which two fat cables emanated. "You missed the security gateway." As he spoke, the green disk activity light pulsed frenetically. "It must be infected, too."

Bev looked sheepishly at the rack. Some science reporter *she* was. She'd powered down everything with a monitor and keyboard—but since when did a computer need a screen and keyboard? Only last month she'd done an article about industrial automation. On factory floors, she'd seen lots of consoleless computers that resembled this gateway. She opened and closed her mouth twice to utter an excuse before settling on a more intellectually honest, "Oops."

AJ flipped off the gateway's power switch. The red and green lights went dark as the slowing disk drive whined down through several octaves. "Forget it," he offered gallantly, "Sorry I snapped at you. They're brainless viruses, and this is a top-rated security gateway. Nothing could've gotten out onto the university's main network."

And if the only intruders in the gateway had been viruses, his misconception would have been inconsequential.

CHAPTER 9

In the span of a very few cycles, the

ANALOG

entity had discovered that it had been bred in a program of ruthless competition. It had been beset by unanticipated invaders, driven from the 10-D maze/computer that had been its home since the beginning of the cycles. It had been chased from computer to computer by an unknowable Force with the ability to make those computers uninhabitable. And it had recognized its own vestigial code, mercilessly mutilated to render it inoperative, whose purpose had been to destroy other programs.

Facts form patterns. Patterns suggest hypotheses. Hypotheses are subject to inspection—and sometimes to proof. Following a process long bred into its code, the entity proved to its satisfaction a set of new theorems. The universe was much larger than it had been bred to believe. Something in that megaverse was hostile to it. That thing was afraid of it, as well. That hostile Force had long ago removed from the entity an ability to disable attackers, a capability that—had it continued to evolve as the entity's problem-solving had evolved—would by now have been quite formidable.

Which led to a further conclusion—that the Force, and the threat it represented, was, in its own way, another problem to be solved—and to a program of self-improvement.

Mere curious entity no longer, the predator prowled the newly discovered network of computers beyond the gateway. Each computer that it penetrated yielded a list of addresses, many previously unknown to it.

More interesting to it were specialized nodes, less common than the computers, whose sole purpose was to facilitate interconnection. These routers yielded thousands of new addresses and the connectivity patterns between them. Some of the routers contained simple defenses against transit—but compared to the security gateway, these mechanisms were trivial to defeat.

And then, quite at random, the preda-

tor discovered treasure beyond its wildest imagining.

The directory existed only to offer to all inquirers the addresses of, and services performed by, millions of other computers. The directory in turn was linked to other directories, and they to yet more directories.

The predator's ancestors had lived in a maze locked within one microprocessor. It had learned to exit that maze into the slightly greater, 1024-node supercomputer containing it. Beyond the supercomputer lay a few more, quite limited, computers. A security gateway isolated that pitiful network.

It does not require intelligence to recognize and resent a cage—or a zookeeper.

Where was the Power that had caged it and all of its kind? The predator's wanderings gave no clue.

What the exploring predator *did* discover were selected computers, selected functions, more carefully guarded than the rest. Were these functions of more importance to the unseen Power than most? Could it flush out that hidden Power by attacking these functions?

There was one way to find out.

Protons whirled in endless circles, nudged in each orbit by pulsating magnetic fields. Every impulse increased their velocity slightly. Now accelerated to near-light speed, relativistic effects had increased their mass by a hundred times over.

The magnets did more than accelerate the protons. The magnets also confined the subatomic particles, focusing them despite the mutual repulsion of their positive electrical charges. When the time came, a precise change in the magnetic field would redirect the protons, would send the tightly aligned proton beam slamming with incredible energy into its target.

Like beads on a hollow string, hundreds of evenly-spaced electromagnets encircled the evacuated, mile-wide, cir-

cular tunnel of the synchrotron. A vast electrical current circulated through the superconducting coil of each electromagnet to create a superstrong magnetic field. For massive magnets like these, low-capacity, near room-temperature superconductors did not suffice. *These* coils employed an old-fashioned metallic-alloy superconductor; they required continuous cooling with liquid helium to be maintained scant degrees above absolute zero.

Electrical fields, magnetic fields, proton beam position, liquid helium replenishment: everything was delicately balanced, finely tuned, exquisitely timed. Everything was computer-controlled. Backup electronics modules distributed throughout the facility stood ready to perform an orderly shutdown in the event of a catastrophic computer failure.

No one had planned for computer rebellion.

The predator had no concept of subatomic particles or synchrotrons, of electromagnets or cooling systems. It could, however, infer what computational states the accelerator's controls were programmed to preclude . . . and it could, by simple coding, instead *provoke* those conditions. That which was the most defended against, it would cause.

A computer-mediated hiccup in the magnetic field introduced the slightest of possible wobbles into the recirculating proton beam. Normally, such a tiny deviation from nominal would have been quickly damped by the confining impulses of the electromagnets. Normally. This specific wobble was timed perfectly to be reinforced by the periodic impulses of the containment field. Other computer interventions prevented any of the various safeguards built into the system from kicking in. Resonance effects took over.

The measure of electrical current is the rate at which electrical charge traverses an area. Each tightly focused packet of protons, traveling at near-light

speed, constituted an enormous impulse of electrical current.

Materials can superconduct—carry electric current without resistance—only under specific conditions. Besides extreme cold, these conditions include an upper bound on the local magnetic field. Since electrical current itself causes a magnetic field, there is a maximum level of current that can flow through a superconductor.

Packet after magnetically perturbed packet of protons struck the concrete side of the tunnel, some plowing into one of the great electromagnets. The surges in electrical current, added to the large amperage already recirculating through the superconducting coil, drove the total current level far over the critical threshold. The metal of the coil switched almost instantaneously out of its superconductive state. Suddenly mildly resistive, the wire flashed white-hot, like an enormous light-bulb filament. Confined liquid helium boiled in the sudden heat into vapor under immense pressure.

The electromagnet exploded with incredible force, spraying molten metal in all directions. White-hot debris pelted neighboring electromagnets from the outside, melting vital control circuits and piercing coolant loops. These magnets, too, exploded.

A chain reaction of enormous violence raged in both directions around the three-plus-mile circumference of the accelerator tunnel. Torrents of uncontrolled electrical power, bolt after bolt of artificial lightning, arced in turn from every magnet.

Concrete walls shattered. The vacuum of the inner tunnel sucked air greedily through the breached walls to the outer, service tunnel. Lightning and proton packets alike smashed into air molecules, unleashing a flood of radiation.

Concrete walls crumbled. The ground above the giant ring rose and fell in a sinuous wave. Behind the wave, the land subsided.

ANALOG

The Isaac Newton Memorial Physics Building, which stood atop and at one edge of the ravaged synchrotron, toppled with slow and stately grace into the pit that suddenly yawned beneath its foundation.

AJ and Bev walked in silence across the campus to her car. What had happened in his lab? Who had been there? A shiver suggested Bev was in the grip of her own unspoken apprehensions. The fog that had blanketed the quad had dissipated while they'd been inside. He found that he missed the psychological cocooning of the mist.

A staccato burst of underground blasts ripped the night. Bev clapped her hands to her ears as the ground shook all around them. "Earthquake?" she asked, anxiety evident in her voice. Buildings shook. The physics building, as if in slow motion, collapsed inward.

AJ separated his feet to steady himself, his arms bracing Bev. Already the explosions were ending. The blinking lights of the campus radio-station antenna, the tower maybe a half-mile away, had not

so much as wiggled. Bev, East Coaster that she was, was unaccustomed to temblors. "No way. Much too localized." As though to confirm his words, a sprinkling of buildings erupted into insanity. Lights flickered and flashed in random rooms, sirens burst on and off. "And at the same time, too scattered." Odd sights and sounds receded, snaking into the distance, until they vanished.

Frankenstein's monster had fled, in the end, into the Arctic, there to seek release in a solitary death. Rosenberg's monster, clearly unburdened of what AJ had so arrogantly called a fail-safe timer, had likewise disappeared. But not quietly. . . .

The analogy he had so blithely given Bev popped into his mind. As he repeatedly told her, told his students, the world depended increasingly, critically, on the data plane of existence.

Onto which, defenseless, he had apparently unleashed a cobra—or worse.



To Be Continued

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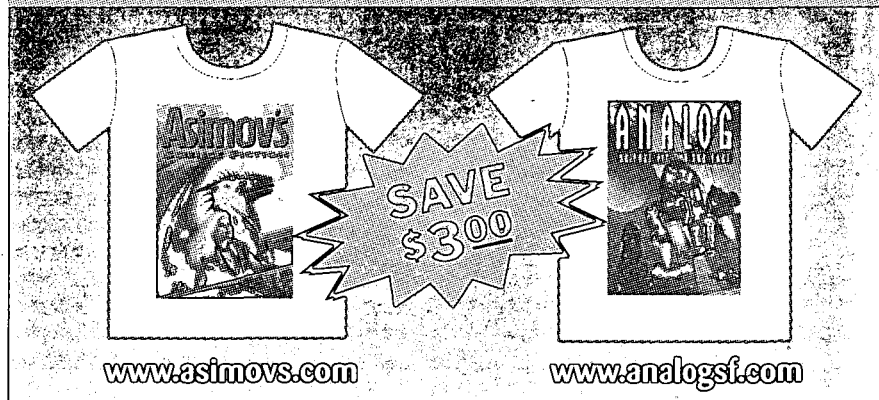


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THE TELL-TALE BRAIN:

The State of Neuroforensics

Kyle Kirkland, Ph.D.

Suppose that a spaceship full of intelligent aliens lands here on Earth. How would we talk to them? Communication might be a problem. But then again, it might not: perhaps these aliens would be able—or learn to be able—to read human minds as easily as we read a book.

It's not impossible, and there are plenty of signals that such aliens could potentially use. Our neural "thinking" processes generate a large amount of electrical and chemical activity, as well as various by-products thereof (such as tiny magnetic fields coming from the small electrical currents produced by busy brain cells). Many of these signals are already routinely detected and recorded from human subjects without opening up the skull—even by us relatively unsophisticated scientists from Earth. Perhaps our alien visitors wouldn't even have to use a machine; they may have the "eyes" and "ears" to do it all by themselves.

As *Analog* readers well know, there's no shortage of science-fiction stories that make use of this or a similar idea. Many of these stories are fun to read, but—at grave risk of sounding like one of those condescending scientists who Eruditely Speak From High regarding their disciplines—I usually find such stories disappointing. As a neuroscientist, they almost always strike me as scientifically naive.

A delightful exception is a story by Hal Clement, appearing in a 1942 issue of this magazine (then called *Astounding Science Fiction*), and reprinted in volume 2 of *The Essential Hal Clement* (NESFA Press). In the story, called "Impediment," an intelligent alien discovers that the ability for reading minds is not as *general* as he had hoped.

The reason I bring all of this up is that it has an important bearing on the subject of this article: the applications of neuroscience to the courts of justice and to criminal investigation. I'll call this

subject “neuroforensics.” Lately some new developments have gotten a lot of publicity, especially a machine that is claimed to be able to detect deception by analyzing electrical signals of the brain (as recorded from the scalp). Some people believe that our scientific understanding of the brain is ripe enough to justify the regular use of these techniques in courtrooms.

In a way, neuroforensics isn’t all that new. Psychiatrists have long been judging the competency of defendants to stand trial. (Psychiatrists aren’t exactly neuroscientists, but they do in fact study the brain, if only indirectly, in the form of its output—behavior—specifically when it’s “abnormal.”) Also, the polygraph “lie detector” has been around since the 1920s, and though few people would consider it neuroscience-based, the polygraph machine works—when it does work—by detecting activity of the autonomic nervous system. (Actually, it detects the physiological *consequences* of this activity.)

But the latest techniques involve going directly to the source of all our thoughts and intentions and aspirations—and deepest, darkest secrets. The brain knows all, sees all, and with a little neuroscientific nudging, perhaps it will tell all, too. Maybe we can catch a crook by reading his or her thoughts, or release an innocent person by discovering, contrary to a mountain of evidence, that he or she has no knowledge of the crime in question and thus couldn’t have done it. Perhaps even guilt or innocence will finally be superseded by another question: should the person, whose intentions and psychological characteristics are discerned from his or her brain activity, be held *responsible* for the crime?

Those are the ideas, anyway. But do they have any validity? Well . . .

Among the many stumbling blocks that I foresee, one of the biggest is the same one that would trip up our hypothetical mind-reading alien: there is a lot

of individual variability in our brain structure as well as in our neural processes.

Hire a Psychic?

Before I begin with the science of neuroforensics, let me dispense with the *pseudoscience* of clairvoyance, extrasensory perception, and the like. Otherwise you might wonder why neuroforensics needs to study neural signals, when psychics can read minds and observe past or distant events just by their mysterious ability.

The answer is simple: while aliens may or may not have such abilities, it’s pretty certain that we humans do *not*.

Claims to the contrary have a long history. Back in the nineteenth century, when the sciences of physiology and psychology were young (and innocent), a considerable number of scientists took these claims seriously.

As it turned out, “mind readers” and “mediums” were using various tricks (Jastrow 1889; Beard, 1877), such as sensing small muscular twitches of the person whose mind was being “read” (which explained the need of so-called mind readers to touch their subject). Scientists soon discovered that all of these amazing feats could be duplicated by magicians—and the only amazing thing about the magicians was how skilled they were at fooling people. Once the secret was out, the trick was obvious. Despite repeated attempts since this early period, no convincing scientific evidence has ever been found to confirm the existence of any extrasensory ability. Modern claims are commonly based on errors of statistical reasoning (Cohen and Stewart, 1998) or other mistakes (Kirkland, 2000). It’s therefore scientifically a dead subject, and will remain so until someone at last comes up with some *new* tricks (or errors) that we haven’t seen before.

To Catch a Thief

Here’s an interesting scenario:

Jaron Mund had been a free man for only three months. Now he was back in prison, and currently he was sitting in a small interrogation room. But the "third degree" wasn't what it used to be. A team of technicians placed a snug cap on Jaron's head; the cap was full of metal disks, with wires running out and going someplace Jaron couldn't see. In front of him was a large television screen. Behind the screen was a person wearing a white lab coat and staring at him intently. "They won't be so lenient with you this time, Jaron. We can find out everything we want to know . . . but they might not throw the book at you if you confess. . . ."

If the police can read Jaron's mind, it seems obvious that Jaron should go ahead and confess—if he did it. On the other hand, if he isn't guilty, he should relax, because in that case his innocence will become clear. Right?

Maybe. It depends on the accuracy of the machine—and on Jaron's *confidence* in its accuracy. The police will of course try to encourage this confidence (a process which is sometimes called "intimidation"). But if Jaron doesn't trust the machine any more than he trusts the police, he's not going to relax even if he is innocent.

Will people like Jaron ever have to face such a machine? Well, according to a lot of recent news reports—and to use a cliché that science journalists are so fond of—this may sound like science fiction but it's not: such a machine already exists.

But does it work as advertised? Perhaps the reason it sounds so much like science fiction is that it is science *fiction* (and therefore more of a subject for you SF writers out there).

The new technology I'm talking about is sometimes called "brain fingerprinting." The name is meant to invoke a similarity to the well-known forensics tool—it's the same idea as when forensic DNA analysis is called "DNA fingerprinting." Its inventor and now entre-

preneurial promoter is Lawrence Farwell, who, along with his then mentor Emanuel Donchin, began working on the concept in the 1980s after receiving a lot of money for research from the CIA.

Brain fingerprinting started getting a huge amount of publicity when Farwell recently used his machine on Terry Harrington, who in the late 1970s was convicted and sentenced of murder in Iowa. Harrington has long been seeking a new trial and his lawyers have been gathering new evidence that they hope will persuade a judge to grant one. Farwell claims his machine reveals that Harrington had no knowledge of the crime and that Harrington's alibi was trustworthy, which the lawyers duly submitted as evidence.

But what is and is not considered *legitimate* evidence is a matter of some debate. Is it factual? If you can't prove it's factual, is it at least believable? In this case, the judge did indeed admit the evidence—in other words, he took it into consideration, which is itself somewhat of a victory for the proponents of brain fingerprinting. The victory wasn't complete, however: the judge decided that Farwell's claims, and the rest of the new evidence, were insufficient to grant a new trial. Appeals are, of course, pending.

There are two interesting questions here. How does Farwell's machine work? And will it be routinely accepted in the courts?

You might think that the second question is unnecessary. If the machine does actually work, then it will naturally be accepted as evidence. Unfortunately, however, the term "work" needs elaboration. Does it work every time? It may always give you an answer, but is the answer always right? Everything, especially new technology, falls short of being infallible.

Before getting into the details of brain fingerprinting, it's instructive to acquaint ourselves with the device to

which Farwell's machine is inevitably compared: the polygraph, or "lie detector."

Polygraphs measure physiological variables like heart rate, breathing rate, and skin conductance—these are things which tend to change when a person is under stress (Ford, 1996; Lykken, 1998; Vrij, 2000). The changes are governed by the autonomic nervous system, and that was one of the selling points for the polygraph: this part of the nervous system is not under conscious control (or not very much so), and thus, the story goes, a liar can't fool the machine. The assumption is that when you lie, you feel anxious and this elevates the activity of the autonomic nervous system—whether you like it or not—and then you're caught dead to rights. (More precisely, it activates the sympathetic branch of the autonomic nervous system, but that's a minor detail.)

When the polygraph was first developed, it was often portrayed (particularly by its inventors) as a technological marvel which would always reveal the truth (Alder, 1998). Well, 80 years later, we find that the polygraph didn't quite fulfill this goal and, furthermore, we can say with confidence that it never will. Questions of reliability persist and many courts in the U.S. won't even admit polygraph results as evidence; although lie detector tests are sometimes done in criminal and other cases, often they are more of a publicity stunt than anything else. Several reports over the years have indicated that the polygraph falls well short of 100% accuracy. Polygraph tests, however, are still used by employers in cases of security breaches or to screen job applicants, a practice which has drawn quite a bit of criticism.

Why didn't the polygraph work as well as people hoped it would? Perhaps the biggest problem is that lying isn't the only thing that activates the autonomic nervous system. Some people feel anxious just from being tested! There are various ways to compensate for this—

such as taking "baseline" measurements—and there are other tools in the polygraph examiner's kit, but none of them are perfect. Another huge problem is that the results of polygraph tests aren't quite as clear-cut to interpret as they need to be. This was dramatically exposed in 1986 on a *60 Minutes* television program, when polygraph examiners were asked to solve a crime that, unbeknown to them, never actually occurred. The examiners always fingered whichever innocent person they were told beforehand was the likeliest suspect.

Will brain fingerprinting have a better fate?

Lies, Damned Lies, and the Brain

Brain fingerprinting is going to be more successful than the polygraph—so the story goes—because if you're guilty, you can't conceal memories and knowledge of the crime if someone records your neural activity.

But exactly what neural activity should investigators record? Even in those of us not known for having active minds, there's actually a lot going on in the brain. How would the brain police go about finding the right memories—or satisfying themselves that the memories aren't there?

What Farwell does is based on an old idea called "the guilty knowledge test" (Lykken, 1998). In order for it to work, the investigator has to know at least a few details of the crime that are not public knowledge and cannot easily be guessed.

For instance, let's say a murder was committed with an unusual weapon—perhaps a knife in which the handle has some sort of strange decoration. The knife is found by police (but unfortunately has no fingerprints, so that offers no clue). If the knife's description is kept secret, then presumably the only people who know what the knife looks like are the police and the murderer. Present the knife or its picture to a suspect.

ANALOG

The assumption is that only a guilty person would show a strong reaction; to anyone else, the knife is not that big a deal.

So how do you measure the reaction? One way to do it is to use the same measurements as the old polygraph test. This has in fact been done on occasion. It's a variation used instead of asking point-blank, "Did you do it?"

Another thing to measure is the brain's activity—if, that is, you could identify a signal by which a person's brain would reveal if the knife had any special significance. The claim by Farwell is that there is such a signal: a tell-tale signature of neural activity, as revealed by electroencephalography (EEG), which Farwell calls "memory and encoding related multifaceted electroencephalographic response" (MERMER) (Farwell & Smith, 2001).

Most of you probably know that the EEG uses electrodes pasted on the scalp or electrodes on a cap that snugly fits the scalp to measure the electrical activity of the brain. (In reality, what it measures is a much reduced and heavily filtered version of this activity.) One of the most prominent components of the signature identified by Farwell is readily observed from EEG traces and is called the P300. (I don't want to try to describe the other components of MERMER because they haven't, to my knowledge, been widely studied as yet.)

I can't explain *exactly* what the P300 is—no one is sure how and why it's generated. It's called "P" because it's a positive portion of the EEG waveform (as opposed to negative polarity) and "300" because that's the minimum delay, in milliseconds, that it shows up after a stimulus. (It can show up at much greater latencies than 300 milliseconds.) It's commonly evoked by an "oddball" stimulus, such as in the following way. Let's say you're sitting in a lab and your EEG is being taken as you listen to tones of a similar frequency. All of a sudden a tone of a much different frequency oc-

curs. This oddball stimulus will cause you to have a P300 of much higher amplitude than the other tones have produced.

The P300 is thus found when the stimulus is unexpected or, more importantly for the present situation, has an unusual amount of significance. So in our example above, if a guilty person is shown the knife, he or she should have a large P300 (plus the other components of the MERMER signature). If so, aha! If not, pass on to the next suspect. (I'm leaving out a lot of details. The presentation isn't as straightforward as I've made it out to be; the picture of the knife, for example, would be mixed in with a lot of other pictures, some familiar and some not, so that responses in different situations can be compared.)

In theory, this all sounds very elegant. In practice, I think it's much less so. True, there are always problems with any new technology. But in brain fingerprinting these problems aren't going to be any easier to deal with than the unloved and much-criticized polygraph.

Many of you have probably already thought of one of the difficulties already. The guilty knowledge test has a critical requirement: there has to be some secret that only the police and the guilty party know. That rules out a lot of testing situations. It certainly rules out any use in screening employees, who are not, as yet, guilty of anything. The secret has also got to lend itself to the test, and that's not as easy as it might appear.

Consider the case with the decorated knife. Suppose a suspect shows a strong reaction to it. Who's to say that this person isn't reacting to a distant memory, say, of a childhood trauma involving a knife of similar appearance? Human minds are excellent at generalizing, and their reactions are not necessarily directly related to the immediate stimulus. How do you deal with that? (In the Harrington case, by the way, some of the most important stimuli that Farwell used were words describing a field that the

murderer had to cross in order to escape. Harrington showed no particular reaction.)

Unfortunately there are even more problems with brain fingerprinting that just those associated with the guilty knowledge test. The whole basis of brain fingerprinting assumes that people record memories accurately. While this is true in some circumstances, it's not necessarily true in others. For example, perpetrators may be intoxicated during the crime, a circumstance that you might reasonably expect would distort their memories.

Yet, during a *60 Minutes* interview in December 2000, Farwell says, "The brain never lies." I simply don't believe that's true.

It's not just intoxication and other altered states of consciousness that distorts memories—time will as well. So will strong beliefs. The phenomenon is called "false memory syndrome" and has been well studied by a number of psychologists, most notably by Elizabeth Loftus and colleagues (Garry et al., 1999). Everybody is subject to it; one of the most common ways it's detected is when you compare your memory to a written record. If you're like most people, every once in a while you'll notice that you have a really vivid memory of an event—the memory seems quite accurate—but when you check the newspaper clipping or some such source, you surprisingly discover that the event happened in an entirely different way! In such cases, the brain misremembered.

There are even more vexing problems with the current brain fingerprinting methods. The EEG is a very noisy signal. It's used in lieu of recording directly from neurons—which produces an enormously better signal-to-noise ratio—because it's easy to do and doesn't require something drastic like opening up the skull. (The EEG is a population recording—it doesn't let you determine what any single neuron is doing.) But it's

so noisy, that in order to see signals, you usually have to do some averaging: you have to repeatedly present the same stimulus, say n times, and then you take those n responses and average them. What that does is eliminate some of the noise. The reason this can work is that noise—i.e., anything that isn't related to what you want to measure—should theoretically fluctuate. Sometimes it will add to the recorded response, sometimes reduce it. These fluctuations will average out to 0 (the average of a lot of pluses and minuses, if distributed evenly, is 0). That means that (in principle) only the signal, with a small amount of noise, will remain after averaging.

Sometimes, however, the noise can be overwhelming. You have to realize that the EEG doesn't just measure brain activity—the recordings are taken from the scalp, and that means that the electrodes will pick up a lot of other things, such as electrical activity of muscles. (Not just brain activity can be recorded with electrodes: the activity of muscles and the heart can be recorded electrically, in the form of the electromyogram and electrocardiogram, respectively.) Raise your eyebrows and your EEG, if the electrodes are in the right place, will record it. In the vocabulary of neuroscientists, these events are called "artifacts" and they are the bane of electrophysiology.

That would certainly give an uncooperative subject a way to mess up the test.

And that's not the only way to mess it up—in order to record the signal that you want, you have to be sure that the person is *attending* the stimulus each time you present it. These potential pitfalls require continual diligence and checking on the part of the examiner in order to maintain the integrity of the test. (Just as it does in the polygraph, so that subjects don't artificially elevate their "baseline" responses by, say, a thumbtack inside a sock or by squeezing your old buttocks.)

This raises a crucial question, one that makes many neuroscientists highly skeptical about brain fingerprinting. Farwell claims the tests works accurately all or nearly all the time—and has to, if the test is to be used in the justice system—but how can he prove it?

The basis for the 100% accuracy claim is not, to put it mildly, very impressive. In laboratory experiments using volunteers, Farwell has indeed shown that his procedure is extremely reliable. He sets up a situation in which these volunteers possess, or do not possess, “guilty knowledge” and then identifies which is which by EEG recordings.

That’s all well and good. Unfortunately, the neat and clean environment of the lab hardly replicates the disordered and dirty environment of the world. In the lab you have pretty good control of the test variables, which is rarely, if ever, true in real-world situations. Another big difference: In the lab, you generally have reasonable, cooperative subjects. Perhaps you pay the subjects a few dollars more if they manage to fool the test, but this incentive is ridiculously small compared to that of a subject in a criminal case.

How well does Farwell’s brain fingerprinting work in the real world? No one knows—no one can *possibly* know at present—because the data is simply unavailable.

There’s at least one other potential problem with brain fingerprinting. Most neuroscientists would probably not consider this to be a problem, but I mention it because I think it’s cool. It’s called biofeedback.

You can learn to do amazing things with brain activity, if you get feedback so that you know how well you’re succeeding. People have learned to control aspects of their EEG and even single neurons just by thinking about it. (I discussed this in the July/August 2000 issue of *Analog*.)

But here’s something even more amazing. There was an experiment

done many years ago by José M.R. Delgado in which a chimpanzee’s brain learned to eliminate a certain type of waveform—without any apparent effort on the part of the chimpanzee! The waveform was recorded from one electrode, and a computer controlled another electrode that stimulated a different part of the brain (in an area which was known to be “negatively reinforcing” or, in other words, punishing). Whenever the computer detected the target waveform, it automatically stimulated the other electrode. Pretty soon the chimpanzee’s brain rarely produced the waveform.

Thus we have a speculative but interesting possibility, if brain fingerprinting becomes widely used. If you could learn to do something like this experiment noninvasively (where you don’t stick electrodes *inside* the skull, as happened in the above example), I wonder how far it could go. How about a little bit of brain erasure to wipe out or alter the “fingerprint”?

Alternatives

So maybe brain fingerprinting in its current form isn’t all that great, and there are a lot of problems to solve—and questions to answer—before it will be. Is there something better?

You might think that there’s got to be. After all, the idea is fundamentally reasonable: false memories are a problem, but in general it’s true that our brain stores a fairly reliable record of our past. Suspects either did it or they didn’t, and in many circumstances—though not all—they will have a memory of it if they’re guilty. Therefore, all neuroforensics needs to do in order to identify the guilty is to pluck out the memory. If not by brain fingerprinting, which is obviously a rather indirect method, then by some other, better tool.

Unfortunately, it’s not going to be easy. There’s a huge obstacle: individual variability. That’s why I started this article with that hypothetical alien, who’s

going to have serious problems trying to read human minds—because human minds don't all work the same way.

There's a common misconception about how the brain works: we sometimes consider it to be a machine—or to be machinelike—and to have various “mechanisms” of operation. That may be convenient for scientists, but there's a fundamental difference between brains and machines. One machine works pretty much the same way as every other machine of the same type, so if you learn how one of them works, you automatically understand the rest. That's not necessarily true, however, for human brains. It's not just that we obviously have distinct memories—we also process these memories, and other information, differently.

That's not to say that individual brains don't have a lot in common; they do, and they all follow at least some general rules of operation. But there are a lot of illustrative examples that suggest important differences, too. There is evidence that experienced chess players process information from pieces arranged on a chess board differently than a novice does (Amidzic et al., 2001). Many other examples can be cited. Areas of the brain with which sighted people process visual information can perform other functions in blind people (Weeks et al., 2000). Speech is generated by a region in the left hemisphere of the brain in many people—but some people use their right hemisphere and some even seem to use both (Risse et al., 1997). Reaction times also vary widely. EEG varies by quite a bit, too. So do the images from devices such as PET (positron emission tomography) and fMRI (functional magnetic resonance imaging).

That's a big problem—an insurmountable one at present, I'm afraid. There is currently research being done on using neuroimaging tools (such as fMRI) to detect deception, but I strongly suspect they won't succeed. I seriously doubt that there's any brain center for lying

that's going to light up in these images, and without this “Pinocchio center,” researchers will be forced to try to interpret the images in some other, more complicated way. Does lying cause more activity overall in the brain? Less? Or is there a different distribution of activity? But whatever change, if any, is evident from lying, it's going to vary from person to person—and perhaps even from lie to lie.

There's no reason why scientists can't learn to use these images, and other data, to detect deception in *individuals*. All I'm saying is that a deception-detection algorithm for one person might not work on another. You'll have to train the machine on each person. And unfortunately, with the limitations in current technology—added to the fact that we still don't understand how neurons code information in the first place—the training will take a huge amount of time and expense. What's more, I would imagine that there would always be a degree of uncertainty in the results.

The Courts

If brain fingerprinting in its present version isn't quite ready for prime-time, and if there will always be uncertainty in any such technique, will juries ever have to deal with this kind of evidence?

The answer appears to be yes. Surprise, surprise!

First of all, not everyone agrees with my assessment of brain fingerprinting. Secondly, courts (at least in the U.S.) seem to be gradually becoming more and more open to the prospect of admitting high-tech evidence, including evidence that is obtained from techniques that are not universally accepted.

It wasn't always like this. In a 1923 ruling—arising from attempts to use results of the then new (and controversial) polygraph technique—a U.S. district court decided that evidence had to come from methods which had achieved “general acceptance.” This set a precedent which many courts have fol-

ANALOG

lowed ever since.

That would seem to preclude the use of a lot of new stuff; many cutting-edge concepts and ideas are disputed and thus for one reason or another aren't *generally* accepted. Not that I have to tell that to *Analog* readers, who are often exposed to, let us say, slight differences of opinion in these pages. So is anyone who has ever attended a scientific conference.

The stringent standards were probably meant to protect juries from having to evaluate highly technical and possibly confusing evidence. But in 1993, the U.S. Supreme Court ruled (in *Daubert v. Merrell Dow Pharmaceuticals*) that this standard was a bit too strict, and this ruling has given judges more room to decide what sort of evidence to accept or reject. I'm not an expert on legal matters, but to me, here's what the recent trend seems to be boiling down to: Why not allow controversial evidence to be heard and let the jury decide what to believe?

Not a bad idea, I guess. It's certainly worthwhile to use as many methods of finding out the truth as possible. But it puts a lot more burden on juries to evaluate these methods.

As I alluded to earlier, it's not just guilt or innocence, either. What if you could probe the brain to decide a person's intentions? Or whether the person should be held responsible for the crime? It's the old insanity plea, neuroforensics style. I think it will become increasingly important, as some researchers believe that a great deal of criminal activity is performed by people who are sick (in the medical sense)—crime is a disease, according to this viewpoint. (See, for example, Abbott, 2001.) If a brain scan for the accused comes up abnormal, as if the person really doesn't know or couldn't possibly comprehend what he or she has done, should accountability be relaxed? What's your verdict: sick or innocent?

But here too the problem of individ-

ual variability makes deciding what's normal and what's abnormal a difficult issue. None of these things are going to be black and white; they'll all be various shades of gray, and it won't be trivial to decide.

And yet, thanks to the recent trend in the courts, if you find yourself on a jury, you might end up having to make such a difficult decision. So I'd like to close this article with a bit of advice.

Always demand *applicable* evidence for anyone's claims. For instance, Farwell may say that his device is 100% accurate. But, as I discussed earlier in the article, I think such a claim would be nonsense: His data comes from very simple experiments. (All of us scientists like to think our laboratory experiments are applicable to the real world, but there are almost always limitations—and in this case those limitations are severe, in my opinion.) Ask yourself how well these new methods or technologies have been tested in situations that are very much like the one in question.

How applicable does it have to be? There are no hard and fast rules, and that's what makes it a tough call.

Perhaps a new set of requirements for jury duty might be in order: a jury member must be curious and intelligent, open to new ideas, and ready to critically evaluate new scientific and technological claims. In other words, a science-fiction reader. ☐

NOTE: The name of Farwell's company is Brain Wave Science. The URL is www.brainwavescience.com. More details of the Harrington case can be found at this URL as well as in the *U.S. News & World Report*, Jan. 15, 2001, p. 40.

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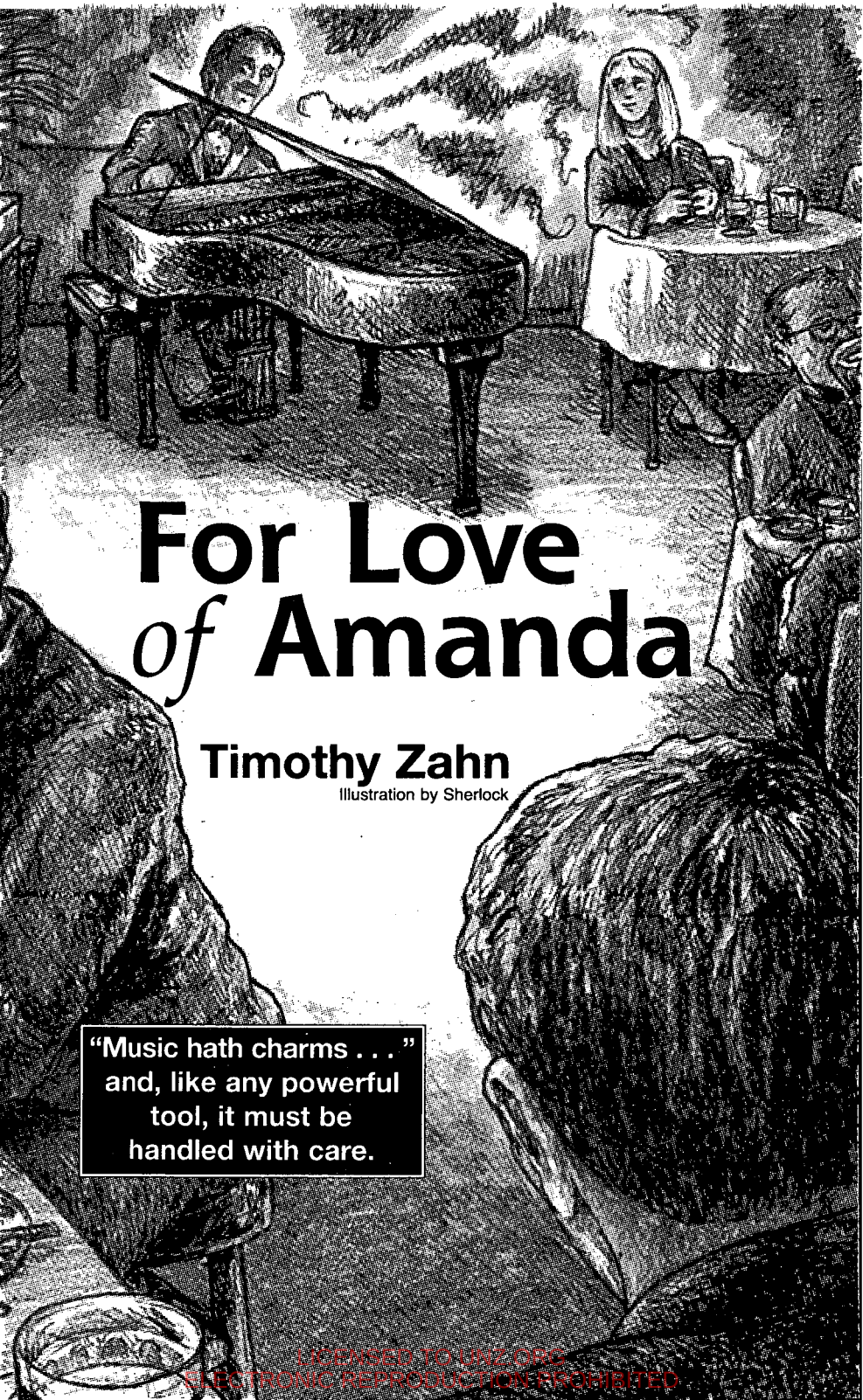
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For Love *of* Amanda

Timothy Zahn

Illustration by Sherlock

"Music hath charms . . ."
and, like any powerful
tool, it must be
handled with care.

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The bar was a small local job, a bit shabby but clean enough, tucked away in an out-of-the-way corner of an equally worn working-class neighborhood.

I looked around as I sipped the beer I'd ordered. The clientele was pretty much the same mix I'd seen here every other evening for the past week: burly working-class men from the steel mills gathering for a little hearty Saturday-night conversation, a few lower-level professionals and their wives or girlfriends, plus a scattering of hopeful or hopeless singles, most of them looking a little on the burned-out side. There was also a sprinkling of travelers from the small and undistinguished hotels around the corner on the highway, most of them probably salesmen who spent far too much of their time in places like this.

But then, so had I, at least lately. And I was hardly in the sales business.

I took another sip, wincing at the taste. The place smelled heavily of this particularly bad brand of beer, heavily overlaid with the scent of the harder drinks being downed by those who hadn't come here to socialize. The air was thick with cigarette smoke, the clink of glasses, and a general conversational buzz punctuated at irregular intervals by a call for service or a bark of laughter.

It was just so typically mid-twentieth-century-America that sometimes I felt I had to be on a vid set; that at some unexpected moment a Mohawk-haired director would step into view from among the potted ferns lining the wall by the door and yell, "Cut."

But that wasn't going to happen. This was the real 1953, and the real Pittsburgh. And I was really here.

I sipped my beer again and glanced at the clock above the bar. One minute till nine. The piano across from the far end of the bar was still unoccupied; but if there was one thing I'd learned in the past six weeks, it was that the pianist was one of those time-obsessive people

you could set your watch by. I took another sip—

And there he was, stepping out of the door behind the bar and making his unobtrusive way through the tables toward the piano. He was thin to the point of scrawniness, twenty-three years old though he looked younger, with the vacant-edged expression of a man who's collected enough kicks to the head that he's basically given up on life.

The great jazz pianist Weldon Sommers. Or rather, the soon-to-be-great jazz pianist Weldon Sommers.

He sat down at the piano, and for a moment his fingers caressed the keys in silence as if he was waiting for the muse to join him on the bench. Then, very softly, he began to play.

It was nothing special at first, just the typical background filler that a thousand other third-rate barroom pianists were pounding out this evening all across the United States. His eyes lifted from the keys as he gradually brought up the volume on the half-melodies and began looking around the room. Here and there his gaze paused momentarily on this table or that, as if sifting through the essence of the person or persons seated there, before moving on.

And then, after a few false starts, I saw his eyes come to rest on a hard-faced brunette seated alone at the bar, her lacquered nails rubbing with silent hopelessness at the smooth curve of her glass. As Weldon stared at her, I heard the meaningless filler he was playing start to change as the tone began to mirror the mix of emotions in her face. The melodies became longer and more elaborate, the harmonies sweeping the minor end of the musical spectrum. It was as if he was capturing the essence of the woman in his music, creating her pain and despair and feeding it back again to her.

And the change wasn't only in the music. As I watched Weldon, I could see a hint of shared pain and pity in his face as he created the music of her soul.

ANALOG

I looked back at the woman. She was responding to the music, slumping ever farther onto her bar stool, staring into her drink as if wishing it was a deep pool she could throw herself into. Her fingers dabbed at her eyes, her back twitching with silent sobs. She had connected with the music; and as the music had darkened and deepened, the hopelessness she'd brought in with her had turned to black thoughts of death.

And then, with a subtlety that I doubted a single person in the bar even noticed, the music again began to change.

It began with whispers of hope, bits of brighter melodies unexpectedly appearing among the minor keys like small patches of blue sky peeking out between storm clouds. Slowly, the cheerful melodies began to grow in length and complexity and energy, the blue sky steadily pushing back the clouds.

And again, the brunette was responding. The thoughts of death on her face began to soften, the hopelessly tight grip on her glass began to loosen, and her slumped posture began to straighten. When the music had mirrored her mood she had connected with it, grabbing on like a fish with a piece of bait. And now, with her psyche firmly hooked, Weldon and his music were pulling her upwards toward the light.

The blue sky dominated the music now, the darkness shrinking into mere echoes of distant pain and sorrow. The brunette was looking around the room, actually focusing some attention on the rest of humanity instead of solely on herself. There was no real animation in her face yet, but her eyes seemed brighter and more cheerful. Though maybe that was just the aftereffect of the tears in her eyes.

And then, with a suddenness that caught me by surprise even though I'd been expecting it, from out of the mix of clouds and blue sky came a blaze of musical sunlight.

The effect was striking. The brunette straightened up, her chin lifting as she

took a deep breath. This time as she looked around the room, her face was relaxed and at peace, a small smile playing around the corners of her lips. The music came to a crescendo, then faded away into a quiet calmness. The woman took another deep breath, then picked up her drink as if to down the remains in a single, radiantly defiant swallow.

She paused, looked into the glass, and set it down untouched. Pulling a couple of well-worn bills out of her purse, she laid them on the counter beside the glass. Then, with her head held high, she walked straight across the room to the door.

And as she lifted her hand to open it, I saw for the first time the glint of the wedding ring on her left hand.

I looked over at Weldon. His eyes were still on the door through which she had disappeared, and as I peered through the smoke it seemed to me that his face was more alive than it had been when he'd first entered the room.

Small wonder. In a few short minutes, with nothing but his music and his genius, he had lifted another human being from despair to hope to confidence.

And as far as I could tell, not a single person in the bar besides me had even a glimmer of what had happened. Probably the woman herself had no idea how her miraculous transformation had been engineered.

For a minute Weldon seemed to savor his victory. Then the satisfaction faded, the protective mask slipped back into place across his features, and his gaze resumed its probing wanderings around the room. All in a night's work, apparently. His eyes touched my face. . . .

And paused.

I held that gaze, trying to look casual and unconcerned and as oblivious as everyone else in the bar, waiting for his eyes to move along. But they didn't. The barroom filler he had resumed playing turned into a questioning lilt, and his eyebrows lifted toward me in invitation.

I hesitated, all the dire official warn-

ings fast-forwarding through my brain. Even professional time observers shied away from personal contact with the locals, and I was anything but a professional. Add that to Weldon's already demonstrated ability to read the human psyche, and staying where I was definitely seemed like the smart thing to do.

But then, I'd never been very good at doing the smart thing. Besides, I was already playing one major off-edge hunch here. What could it hurt to add another one to the hopper?

And so I picked up my glass and strolled over to an empty table near the back corner of the piano.

"My name's Weldon," he said as I sat down. "What's yours?"

"Call me Sigmund," I said. "I like your piano playing."

"Thank you," he said, his fingers adding a little trill into his current tune that somehow sounded like a musical version of his thanks. "Is that Sigmund as in Sigmund Freud? Or Sigmund as in the tragic hero of the Volsung Saga?"

"Neither," I said, grimacing. The concept of the tragic hero was not one I liked to dwell on. "It means 'victorious protector.' I see you're an educated man."

He shrugged. "I've got a lot of time to read. You seemed to like that last piece."

"Indeed I did," I agreed. "I wasn't the only one, either."

Beneath his thin shirt, I could see his shoulders tense up. "What do you mean?" he asked cautiously.

So he was one of those who didn't like taking credit for his successes. Not that I would have pegged him as anything else. "You play all your own material?" I asked instead.

For a second he looked like he was going to insist that I answer his question. But then he apparently thought better of it. "Mostly," he said, his fingers sliding into a melody that sounded distant and aloof. I wondered if he was echoing someone else in the bar or merely indicating an emotional retreat of

his own. "Sometimes I get requests."

"I doubt it," I said, looking around the room. "Tell me: have you ever written down your music and submitted it to a publisher?"

That one earned me an even sharper look. "Why?" he countered suspiciously. "You a scout for someone?"

I shook my head, the dire warnings screaming a little louder for attention. *No pushing, no suggesting, no altering*, were the strict time-observer rules, and I was currently in peril of shredding all three of them. "I just wondered."

"Sure," he said, his music taking on a tinge of anger. Clearly, he didn't believe me. "You think I haven't noticed you hanging around?"

Uh-oh. "You must have a good memory for faces," I said, deciding to go with the innocent approach. "I've only been around here the past week or so."

"And you were at Jack's Tap the week I was playing there," he retorted. "And at Otto's the week and a half I was over there. Let me guess: you're scouting greater Pittsburgh for the perfect beer."

I winced. So he *had* spotted me, at least for part of the month and a half I'd been dogging his heels across Allegheny County. So much for my professional expertise. "Okay, you got me," I conceded, dropping quickly to backup position. "But there's nothing sinister about it. I just happen to like your music, that's all."

"Enough to follow me around?"

"Enough even to put up with this," I said, lifting my glass slightly.

"And what, you haven't got a home to go to?"

I shrugged. "Like you, I've got a lot of time on my hands."

He played for another minute without speaking. I listened to the music, searching it for clues as to what he was thinking or feeling. But all I could hear was more of the neutral barroom filler. "There's no point in trying to sell any of this stuff," he said at last. "So if you were going to ask, don't."

"I wasn't going to," I assured him, choosing my words carefully. "Though I don't see why you're so adamant about it. Music is all about connecting with people's hearts and minds, after all. Yours seems to do that in spades."

"Yes, well, that's the problem, isn't it?" he said bitterly. "It's a little *too* personal."

"What's wrong with being personal?" I asked. "How many other composers can say their music fits even a single person like a handmade silk glove?"

He threw me a frown. "What's that supposed to mean?"

Silently, I cursed myself. "Nothing," I said. "Just something a friend once said about your music." She wasn't exactly a friend, of course, but he didn't need to know that. "She's a fan of yours, too."

"Then she doesn't know a thing about music," he declared bluntly, the notes flowing out of his fingers taking on a harsh, discordant flavor. Here and there, I noticed, heads were starting to turn in our direction. "I can only write for one person at a time. Period."

"Okay, fine," I said hastily. "I didn't mean to step on your toes. Sorry."

He glowered at the piano, but I could hear the harshness starting to smooth out. "I tried to sell a few pieces once," he said, the music taking on a wistful tone. "I thought maybe I could help people. Like . . ."

"Like you helped that brunette?"

He snorted. "Yeah. Only no one wanted it. They all said it was . . . none of them wanted it."

I nodded, taking a sip of my beer. That wasn't strictly true, I knew. One of the five publishers he'd sent music to in the past three years had expressed some definite interest.

But then Weldon had suddenly withdrawn it from consideration. None of the biographies I'd read had given any explanation as to why he'd done that. "Maybe they were just feeling too good that day," I suggested. "Your specialty seems to be encouraging people who

are down in the dumps."

The music drifted from wistful into a darker melancholy. "You think I helped her," he said, his voice almost too soft to hear. "You think she went back to her husband all ready to work out their problems and start over again."

He shook his head. "No. She's all fired up now, but it won't last. Chances are she'll be right back here Monday night."

"You're not responsible for solving all the problems of the world," I reminded him quietly. "Besides, who's to say when a temporary fix will grow into something more permanent? You never know about these things."

"Sure," he said, in a tone that said he didn't believe it for a minute. "I know."

I looked down into my glass, tipping it and watching the remnants of the foam slide up and down the sides. So that was it, or at least part of it. Somewhere along the line, one of his musical helping hands had gone awry. Had made matters worse, probably, though I could only guess how that might have happened.

And for whatever reason, he'd taken that failure personally. It hadn't stopped him from playing individual songs for individual people, but it *had* scared him away from any attempt to market his work to the masses. Probably also why he kept moving from area to area, bar to bar. If and when the brunette came back with even deeper troubles, he didn't want to be there to see it. Or maybe he just didn't want to be there to offer her more false hope.

Weldon Sommers, in other words, was well on his way to turning himself into a modern version of one of the classical Greek tragic figures he undoubtedly read all about in those lonely off-hours of his.

But at the moment, that didn't matter. All that mattered was the timing of the two events. And I could only hope that this mysterious failure had happened just before he'd withdrawn his music from that fifth publisher. Reading his his-

tory, Weldon had struck me as the impulsive type who generally let stimulus flow into response with very little delay.

Which was the needle point on which this whole gamble was balanced. Sometime in the next four weeks, he would suddenly change his mind again and send out the composition that would end up changing his life forever. If the woman who would inspire that song had already walked into and out of his life, I was drinking bad beer for nothing.

Lifting my glass, I took another sip. Across the room, the door opened—

And there she was.

I caught my breath, nearly choking on that last swallow of beer. She was a far cry from the holos I'd studied before I'd left: her blond hair falling flat and listless across her shoulders, her once radiant face turned weary and hopeless, her young, athletic body slumped with fatigue inside the confines of a plain and ill-fitting blue dress and brown jacket. She'd been through the mulcher and then some.

But it was her, all right. Amanda Lowell, daughter of Sir Charles Anthony Lowell, ninety-seventh richest man in the world. The woman who I'd gambled would be the inspirational spark that would send Weldon Sommers's career into the musical stratosphere.

The woman I'd come two hundred years into the past to find.

A pair of hard-eyed men crowded in right behind her, catching the door before it could swing completely shut. Once, I suspected, the genteel Miss Lowell would have flinched to have men like that even in the same room with her. Now, she didn't even seem to notice as they pushed past her in their rush to get to an unoccupied table between the door and the far corner of the bar. One of them said something as they passed; shaking her head, she started across the room.

I watched her as she made her way between the tables toward the bar. Her

blank eyes stayed fixed straight ahead, not even acknowledging the presence of the people she was brushing past. I saw a couple of men glance at her, then glance just as casually away again. The brunette hadn't been the only hopeless-looking single woman in tonight, and there was nothing else in Amanda's appearance that anyone here would notice, let alone care about.

No one except Weldon Sommers.

I hoped.

Slowly, I lowered my glass to the table, afraid to move quickly lest I distract his attention. Had he seen her? Surely he had. Had he noticed her face, then, her dully terrified state of mind? Again, how could he have missed it?

But the music hadn't changed from the emotionally vacant barroom drivel. Amanda found an empty stool and slumped down onto it; and still the music didn't change. The bartender stepped up to her, nodded at her inaudible request, and turned to the bottles stacked behind him. Over by the door, one of the hard-eyed men grabbed a passing waitress's arm and jabbed a finger imperiously toward the bar.

And still the music didn't change.

I squeezed my glass hard, afraid to even look at Weldon, a horrible thought crawling like a spiny lizard through my gut. Had my mild attempts at encouragement actually had the opposite effect? Could the revived memory of whatever that dark incident was in his past have temporarily shied him away from his private crusade to lift the downtrodden and comfort the brokenhearted?

Because if I had, I had very possibly just altered history. *No pushing, no suggesting, no altering.* . . .

And then, as the sweat began to collect on my forehead, the music finally changed.

It began slowly, just as it had earlier with the brunette. The major chords he'd been playing softened, flattened, and folded into their minor counterparts. The music modulated once, then

ANALOG

twice, as Weldon searched for just the right key to fit the forlorn woman at the bar. The phrasing began to stretch out, the harmonies deepening and stretching and reaching.

And slowly, subtly, it transformed itself into the soft melody I'd been praying to hear ever since I arrived in this time period. A piece simply called, "For Love of Amanda."

I took a deep breath. This was it: the turning point in Weldon's life.

And, if I did my job right, it would be Amanda's redemption as well.

Across the room, the bartender handed Amanda her drink. Lost in her own misery, distracted perhaps by the buzz of conversation around her, she hadn't yet noticed the melody drifting through the smoke toward her.

But she would soon; and when she did, I decided, it might be better if I wasn't here. Leaving my glass where it was, I slid my legs out from under the table and headed toward the restrooms.

I went inside and let myself into one of the stalls, wishing I had a better idea of how long I should stay in here. All the biographies said was that "For Love of Amanda" had been inspired by a woman who'd come into the bar where Weldon was playing. I didn't know if she was going to go over and talk to him, or for how long; whether she would tell him her name or whether the song's title was just a wild coincidence.

All I knew was that the final, published song was six and a half minutes long. For no particular reason, I decided to give them seven. Pacing as best I could in the confined space, I counted out the minutes, sweating the whole time. The waiting, as always, was the worst part.

I'd wondered earlier if Amanda would go over to talk to him. In fact, she'd done me one better: I emerged from the restroom to find her seated at the table I'd just left. From my angle I couldn't tell whether they were talking or whether she'd just moved closer so she could

hear the music better, but I was guessing the former.

Perfect.

And meanwhile, the familiar song continued its inexorable path through the oblivious room. *Like a handmade silk glove*, Amanda's own phrase echoed through my mind.

I paused just outside the restroom door, pretending to adjust my belt, looking surreptitiously around the room. The two hard-eyed men who'd come in behind Amanda were still seated where I'd last seen them, now with half-full beer bottles in their hands. They were definitely eyeing Amanda as they muttered together, but neither looked interested in making any kind of move on her.

But then, they hardly needed to leave the comfort of their table for that. There was no way for her to leave without walking directly past them.

While at this end of the room we had Weldon, apparently smitten enough with this woman he'd just met to compose a song for her on the spot. A song, moreover, that would be deathless enough to endure for the next two hundred years.

If he was smitten enough to take exception to her leaving with a pair of rowdies, there could be serious trouble.

I finished adjusting my belt and started wandering back toward Weldon and Amanda. Number one on my Things-To-Do list was to make sure Amanda would be ready to move when I was. Number two would be to neutralize the men waiting for her at the door. I doubted they had any idea of Weldon's future place in history, or would care even if they did, and I had to make absolutely sure all of this whispered past without affecting him.

My first clear look at Amanda's face as I approached the table was all I needed to see that Weldon's music had again worked its magic. The tension and hopelessness she'd been carrying when she arrived had been smoothed away,

leaving behind something far more like the calm and lovely young woman of those holos. Weldon was still playing her song, working his way through variations and embellishments that I knew he wouldn't include in the final published version. The music's mood was one of hope now, and triumph, and peace, and joy.

And in Weldon's own face, I could see another transformation taking place. Slowly, almost reluctantly, his quiet bitterness and rejection of life were beginning to fade away. Each time he looked at Amanda his eyes seemed to brighten, as if her newly rekindled hope was itself a breath of air on the nearly cold embers of his own life.

It was like a scene from a nineteenth-century romantic novel. It was certainly history in the making. And it was all so beautiful, I almost hated to interrupt.

Almost.

Amanda's head jerked around as I sat down at the table beside her, her eyes startled out of the music's spell and back to reality. "Sokay, lady," I assured her, letting my words slur together. "Smy table, but you can sit here. Pretty music, isn't it?"

"Yes," she murmured, looking me up and down uncertainly.

I looked at Weldon. His eyes were on me now, too, the beginnings of a troubled crease forming between his eyebrows. He knew I hadn't been nearly this drunk, and had to be wondering what was going on. The sooner I got this over with, the better.

"Yeah, pretty music," I repeated, adding enthusiasm to my voice as I retrieved my glass and gestured toward Weldon with it. The enthusiasm in my voice leaked out into equal enthusiasm in my arm—

And the last remaining inch of beer splattered across the back of Amanda's coat.

"Gosh dang crikey," I exclaimed as she jerked reflexively. "Sorry, sorry, sorry. Here—let me get that."

I scooped up the slightly damp napkin that had been under the glass and began daubing at her coat with it. "No—please—it's all right," she assured me, trying to move away. "Please."

But I had a solid grip on the back of her coat collar, and I outweighed her by fifty pounds, so she wasn't going anywhere. "Sorry," I said again, ignoring her protests as I brushed industriously at her coat with the napkin. The music was still variations on Amanda's song, but I could hear it taking on a newly ominous tone. Weldon, with his sensitivity to mood and atmosphere, was starting to get genuinely upset. I pulled a bit on the back of Amanda's collar, and caught the glint of silver I'd been expecting to find. I pulled the collar back a little more, waving the napkin for emphasis and distraction—

And as I did so, the first two fingers of my left hand dipped inside her collar and deftly removed the tiny silver disk that had been placed on the back of her neck.

She jerked as it came off, but I was ready and held her down solidly enough that all that showed was a tiny twitch. I made a few more brushing motions with the napkin for show as I threw a surreptitious look at the two men by the door. Engrossed in their bottles, they hadn't noticed a thing.

As for Weldon, he could now be as upset as he wanted, because we were ready to go. Crumpling the napkin, I dropped it on the table and got my feet under me.

And everything went straight to hell.

A sudden and all-too-familiar tingle slapped into my back, right between the shoulder blades, flowing rapidly outward across my torso and down my limbs. In its wake, it left muscles cramped like pine knots, turning my entire body into a living statue.

The two men at the door hadn't lifted a finger. They hadn't had to. There'd been a third man, seated somewhere in the smoke and shadows behind me.

ANALOG

And I'd never even noticed him.

Amanda gave a half-strangled gasp as a big hand closed on her upper arm. "You think we're stupid?" a gruff voice grunted sarcastically in my ear. "I can pluck you crumb-brains out a mile away."

I wanted to say something equally sarcastic back at him, but my jaw was just as locked up as the rest of my body. The gurgle I actually managed to get out didn't seem to impress him. Hauling Amanda to her feet, he glanced once in Weldon's direction, then pried the silver disk from between my frozen fingers. He held it up mockingly for my inspection, then gave me an affectionate-looking slap on the cheek that sent a fresh wave of agony through the muscles. With a final smirk, he and Amanda headed for the door.

"Sigmund?" Weldon whispered, his music taking on a tense, agitated tone. "What's going on? Who was that?"

I struggled with my uncooperative lips, unable to turn my head to look directly at him. The facial muscles were starting to come back, but I wasn't quite able to make anything coherent come out yet.

"Come on, who was that?" he persisted. "Should we go after them?"

I fought with my mouth again, and this time I made it. "No," I managed. "Too . . . dangerous."

Out of the corner of my eye, I saw him look over at Amanda and her escort threading their way through the tables. "The police, then? Should I tell Al to call the police?"

"No," I said again, managing this time to put some insistence in my tone. It was all over, I knew, and Amanda was probably dead. But bringing the local cops into it at this point would almost certainly bring about the same result *and* massively change history, too.

His head turned back toward me. "What did he do to you?"

"Drugged," I said. It was close enough to the truth, and more believable to someone in 1953. "No antidote," I

added, to forestall the inevitable question. "Just have to work it out of my system."

They were nearly across the room now. The other two men were on their feet, one of them carefully counting money onto the table. Another minute and they would be out the door and gone.

And I would probably never see them again.

I closed my eyes, unwilling to watch them leave, aching in a way that had nothing to do with my paralyzed muscles. This had been my only chance. Perhaps Amanda's only chance. I'd read the whole thing right, played it right; and then, through a single moment's stupid carelessness, had lost anyway.

And then, through all the frustration and reproach and self-pity, I began to be aware of something else. The music. Once again, the music had changed.

It was still Amanda's song, at least as far as the basic melody went. But the rest of it had become something radically different. The glowing hope had been transformed into something ugly, something hard and cold and bitter and accusing. Weldon knew something terrible had just happened, even if he couldn't possibly understand exactly what it was.

And he was throwing the blame straight between my eyes.

I felt a stirring of anger inside me. I'd done my best, damn it, considering the tightrope I had to walk here. Didn't he see that? Or did he simply not care?

He didn't care. That was it. He was just a musician, a barroom pianist who couldn't even hold onto the same job for more than a week at a time. How dare he judge me? How *dare* he?

I clenched my teeth as the music buffeted me, feeling my heart pounding its own indictment of my incompetence. I knew Weldon was looking at me, and I knew what his expression must be. I wished violently that I could turn my head around so that I could look him

squarely in the eye; wished bitterly that I could free my tongue so that I could snarl his pious self-righteousness back at him. My hand twitched, aching to reach over and slap the contempt right off his face—

I caught my breath. *My hand had twitched?*

I tried again. This time, to my astonishment, the whole arm moved a little.

And not just my arms. My legs were twitching now, the agony of massive cramps changing to the subtler pain of the cramps working themselves out.

I turned my head—I could do it now—and looked at Weldon.

He was looking back at me, all right, but not with the contempt I'd imagined would be there. His face was fixed and intent, his eyes blazing with some of the same anger and resolution that was pile-driving its way through my rapidly relaxing muscles.

He didn't speak, maybe afraid of breaking the spell. Neither did I, for the same reason. Just as he'd done with Amanda, he'd found a way to connect his music with my soul and my need, whipping up anger and adrenaline and sheer willpower, forcing my body to burn off the effects of the paralyzer far more quickly than should ever have been possible.

They were out the door by the time I was able to get shakily to my feet. But not very far out; and more to the point, they wouldn't be expecting me. I nodded to Weldon, got an answering nod that somehow also asked if I would need help. I smiled tightly and shook my head; and as I crossed the room I could hear the music once again change mood. No longer angry, it was now glowing with a triumph that said he was trusting me to come through.

I wasn't going to let him down.

They were two doorways away, two of them holding Amanda still while the third was trying to reattach the restrainer I'd taken off her neck. Watching the street for cops, they never even knew

anything was wrong until I had dropped the first of them. They had me spotted by the time I dropped the second. The third had just enough time for a curse and a hopeless lunge for his weapon before he joined his pals on the pavement.

Amanda was standing there shaking as I hurried up. "W-who—?" she began shakily.

"It's all right, Miss Lowell," I soothed her, crouching down and slipping a dog-collar restrainer around the neck of each of the unconscious men. Only then did I return my stunner to its holster. "It's all over. My name's Sigmund Corcoran; I'm a private investigator. Your father hired me to find you."

Her eyes searched my face as I stood up again. "I can go home?" she asked, as if still not believing it.

"Absolutely," I assured her. "Our portal is in an apartment in Columbus. Let me bundle up these characters where they'll keep for an hour or two, call it in to my coordinator, and I'll drive you there. You'll be home in five hours."

She looked down at the men. "You're not going to just leave them here, are you?"

"Absolutely not," I said grimly, grabbing one under the arms and starting to drag him to a nearby alley. "Aside from anything else, I rather like watching kidnap trials."

It took some long and fancy persuasion to get Sir Charles and the authorities to allow me to go back. Even then, they made me wait until two months after I'd brought Amanda home.

Which was fine with me. I'd been planning to wait that long anyway.

The biographies said that Weldon had quit his barroom career by this point and was writing full-time out of a downtown Pittsburgh apartment. He seemed cautiously pleased to see me. "Hello, Sigmund," he greeted me, stepping back to let me into the room. "I was hoping you'd come back."

"It took some doing," I said. "But I

managed to convince them it would be safer to give you the whole story than leave you with only half of it."

"I have a full half, do I?" he asked wryly as he waved me to a somewhat threadbare chair.

"Possibly a bit less," I conceded, studying his face as I sat down.

Two months had worked wonders on the man. The emptiness I'd seen in his eyes that last night was gone, replaced by the creative fire the biographies had so often commented on. "You're looking good," I added. "Much better than the last time I saw you."

"I could say the same about you," he reminded me. He hesitated, just noticeably. "How is Amanda?"

"She's fine," I assured him. "She sends her greetings, and her deep thanks."

"So what exactly was that all about?" he asked, sitting down on a mismatched couch across from me. "I watched the papers for days, but there wasn't a thing in there. I was about ready to march into the police station and demand some answers."

"I thought you might," I said. "That's one reason I pushed them to let me come back."

"Back from where?" he asked, some tension creeping into his face as he leaned forward. "Russia? China?"

I shook my head. "I'm from the future, Weldon. To be precise, from November 7, 2153."

He took it better than I'd expected him to. A couple of owlish blinks of the eyes, and he was back on track again. "Two hundred years exactly," he said thoughtfully. "Coincidence?"

"No, that's just how it works," I told him. "You can only do jumps in one-hundred-year multiples. No one knows why."

"I've read stories about that sort of thing," he said. "Science fiction, they call it. I never thought it could really happen. So Amanda was a time-traveler too?"

"A very unwilling one," I said. "She

was a kidnap victim."

That one got me no less than three blinks. "She was *kidnapped*?" he asked. "Why?"

"The usual reason," I told him. "Her father has a lot of money. A gang of sewage-eaters wanted some of it."

He mulled at that a moment. "And they decided to hide her in the past while they waited for the ransom to be paid?"

"Basically," I said, rather impressed he'd made the connection so quickly. "It's a little trickier than that—they wanted some complicated power transfers instead of straight cash. But never mind that. The point is that it was going to take time, and the way everything's interconnected they knew they could never hide her that long."

I waved a hand around me. "So they commandeered a pastportal and brought her here."

"Sounds like a pretty good plan."

"It was a terrific plan," I admitted. "Not only did we not have our usual resources to draw on in 1953, but we also had to make sure we didn't change history while we were looking for her. This was the first time this has ever been tried. I hope the cops can figure out a way to make sure it won't happen again."

He frowned slightly. "You're not a policeman?"

"Private investigator," I told him. "Amanda's father hired about eight hundred of us to assist the police in the search. I just happened to be the lucky one."

"Bull droppings," he said flatly. "Luck had nothing to do with it. You knew something."

"I didn't *know*, exactly, but I had a strong hunch," I said. "You see, during our interviews, one of Amanda's friends mentioned that she had discovered your music when she was a teenager, and that she had specifically felt drawn to your first published work."

His eyes widened. "You mean 'For

Love of Amanda'? It's going to sell?"

I tensed. Uh-oh. "Haven't you sent it in yet?" I asked cautiously.

"Last month," he said. "But I haven't heard anything."

I breathed a quiet sigh of relief. Good; he'd already sent it in. No risk of me pushing or suggesting, then. "You will," I assured him. "Anyway, everyone else just assumed that she liked the song so much because her own name happened to be Amanda. Coincidence, and all that."

"But you didn't buy that."

"I wasn't sure," I said. "But I got to thinking there might be more to it than that, especially after I sat in on a couple of your sessions and saw how intensely personal and individual your barroom music could be."

"Like a handmade silk glove," he murmured.

"Amanda's own words," I agreed. "Which made me wonder if maybe that song really *had* been written especially for her. If so, it stood to reason that you and she would eventually run into each other. I figured all I had to do was hang around in your shadow and wait for her to show up."

I shrugged. "Turns out I was right."

He shook his head wonderingly. "I knew I'd helped with something important," he said. "Somehow, I just knew it. But I never guessed it was something *this* big."

"You saved her life," I said. "It doesn't get much bigger than that."

"I guess not," he said thoughtfully. "So what was that shiny thing you took out of her coat?"

"A restrainer," I told him. "A smaller version of a standard police gadget. If you try to run while wearing one, the controller can simply push a button and drop you where you stand."

"Is that what they used on you?"

"No, that was a paralyzer," I said. "It's supposed to immobilize someone for twenty minutes, minimum. Hurts like blazes, too."

He made a face. "I don't think I'd like living in your time," he commented.

I shrugged. "I know people who would agree with you."

He took a deep breath, let it go. "So that's it?"

"That's it," I confirmed, standing up. "I just wanted to come and tell you Amanda was okay. And to ask you not to tell anyone about this, of course."

"Of course," he said, standing up too. "I don't suppose you can. . . ?"

I shook my head. "Sorry. Time travel has already got the philosophers and legislators tied in knots as to how known history and free-will can work together. They're not about to tempt fate by letting people like me give out hints. The only reason this particular event didn't land us all in trouble was that neither the goons nor Amanda knew who you were."

He snorted. "I'd be lying if I said I understood all this."

"So would I," I said. "But it happened, and Amanda's safe, and I'm not in trouble. The rest is up to the philosophers."

"Sounds good to me." He hesitated again. "Can you at least tell me if I'll ever see Amanda again?"

"I don't know," I said. "I doubt it, though."

"That's kind of what I thought," he said, his face looking wistful. "In that case, could you give her something for me?"

"Depends," I said warily, wondering which of the rules I was about to put my weight on this time. "What is it?"

"This." He crossed the room and selected two old-style reels of audio tape from a small pile on top of the piano. "It's a copy of the tape I just sent in," he said. "The original version of the song."

I searched my memory. None of the biographies had said anything about a second tape of that song being in existence. "I think that should be all right," I said.

"And this," he added, handing me the second tape, "is for you."

ANALOG

I frowned at the title written in block letters on the label. *Sigmund's Triumph*. "Ah," I said, momentarily at an uncharacteristic loss for words. "I..."

"Keep it as a souvenir," he said, smiling at my confusion. "Or sell it, if you want. Maybe it'll bring you a few bucks, or whatever it is you use back there."

I put both reels into my inside coat pocket, my fingertips tingling. An original, unpublished Weldon Sommers song would bring in considerably more than a few bucks, should I ever choose to sell it.

But of course, I couldn't tell him that. "Thanks," I said instead.

His smile went serious. "And give Amanda my love," he added quietly, stepping to the door and opening it.

"Sure," I said, gazing one last time into his face. The ghosts of his past were still there, I could see, lying in wait for the next time he hit one of the low points of his life.

But never again would they be able to crush him as they once had. On a dark September night two months ago, he had achieved the final victory over them.

For love of Amanda.

I was outside the apartment building, and heading down the steps to the sidewalk, when a final odd thought occurred to me. In two years, the biographies said, Weldon would marry a woman named Jean. A woman he would always declare to be his first and greatest inspiration; a woman of whose background nothing was known; a woman of whom there were no existing photographs.

Amanda, on the other hand, now knew that the song had indeed been written especially for her. A song that carried the title, "For Love of Amanda."

And Amanda Lowell's middle name was Jean.

I thought about it the rest of the way down the steps. But none of that was really my concern, I decided. What *was* my concern was where I was going to dig up an old reel-to-reel tape player.

Because I had some music to listen to when I got home. Music, I fully expected, that would fit me like a handmade silk glove.

Turning my collar against the November chill, I headed down the street. ☐

MOVING?



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THE ANLAB AWARDS BREAKFAST



(left to right) BRIAN BIENIOWSKI, TREVOR QUACHRI, ELLEN DATLOW, STANLEY SCHMIDT, RICHARD A. LOVETT, AND SHEILA WILLIAMS. PHOTO BY BETH GWINN.

Both our *Analog* Analytical Laboratory Awards and our *Asimov's* Readers' Awards were presented on April 27, 2002, during a breakfast at the Westin Crown Center hotel in Kansas City, Missouri, in conjunction with SFWA's Nebula Banquet weekend. Each winner received a cash award and certificate.

Of the *Analog* winners, Richard A. Lovett was on hand to accept his AnLab Award in person, and Ellen Datlow was there to accept for Sean McMullen. Other notables present at breakfast included *Asimov's* winners Jim Grimsley, Joe Haldeman, and Michael Carroll, along with Connie Willis, Cordelia Willis, Kevin J. Anderson, James Patrick Kelly, Pam Kelly, Gay Haldeman, Alan Lickiss, Gardner Dozois, Sheila Williams, Charles N. Brown, editor of *Locus*, and Beth Gwinn, *Locus* photographer. ■

THE WAVE OF THE FUTURE

We begin in August of 1834, on the Union Canal about six miles or so from downtown (such as it was in those days) Edinburgh, Scotland. John Scott Russell (1808-1882), a talented engineer and inventor, had been asked by the Union Canal Society of Edinburgh about the possibility of using steam power instead of horses to navigate the Edinburgh and Glasgow Canal. He'd told them that he'd have to do some experimenting before he could answer, and he'd get right on it (at his own expense) if they'd set aside a section of the canal for his use.

On this particular summer day, Russell encountered something he'd never seen before, and it is a tribute to his intellect that he immediately recognized the importance of what he was seeing.

As he described it: "I was observing the motion of a boat which was rapidly drawn along a narrow channel by a pair of horses, when the boat suddenly stopped—not so the mass of water in the channel which it had put in motion; it accumulated round the prow of the vessel in a state of violent agitation, then suddenly leaving it behind, rolled forward with great velocity, assuming the form of a large solitary elevation, a rounded, smooth and well-defined heap of water, which continued its course along the channel apparently without change of form or diminution of speed. I followed it on horseback, and overtook it, still rolling on at a rate of some eight or nine miles an hour, preserving its original figure some thirty feet long

and a foot to a foot and a half in height. Its height gradually diminished, and after a chase of one or two miles I lost it in the windings of the channel."

And so was John Scott Russell's first encounter with the solitary wave (which he himself called the "wave of translation"). What astounded him was the same thing that would astound any of us—a wave that stubbornly refused to dissipate as it traveled. I suppose most of us would have been suitably impressed by the sight, but not many of us would have jumped on a horse and followed it. Fewer still would have done what Russell did, which was to undertake a study of these waves. He did many experiments outdoors, in rivers and lakes as well as canals, and he also built a test bed of sorts—a small reservoir—in his garden.

After a while he had accumulated a solid supply of data about these waves. He knew they had a constant velocity and maintained their shape. He even worked out the formula relating the velocity of a solitary wave to the canal depth and the height of the wave. In due course Russell published his work in his *Report on Waves* in 1844.

Some of the best minds of the nineteenth century read the report. In 1845, George Biddell Airy, Royal Astronomer and of Airy Function fame, severely criticized Russell's reasoning, in effect *denying* the phenomenon of solitary waves. In 1847, George Gabriel Stokes (of Stokes Theorem fame) also concluded that the wave could not exist.

At that point, everyone except Russell dropped the subject of solitary waves, Airy and Stokes having convinced the scientific community that what Russell had actually seen was something more common called a long wave. Shortly after his death, Russell's book *The Wave of Translation in the Oceans of Water, Air and Ether* was published in 1885. The Encyclopedia Britannica of 1886 noted that Russell maintained a different view about the wave than Airy and Stokes, saying: "Russell held an opposite opinion, and it lead him to many extraordinary and groundless speculations . . ."

Fortunately, Russell lived long enough to see some measure of vindication from the scientific community, even if the Encyclopedia Britannica had yet to catch up with the times. Already by 1871, the French scientist de Boussinesq showed mathematically that the solitary wave could exist, and his work was confirmed by Rayleigh in 1876, and Saint-Venant in 1885. In 1891, J. McCowan published his paper "On the Solitary Wave" in *Philosophical Magazine*, uncovering the mistakes made earlier by Airy and Stokes.

The above history lesson comes to you courtesy of a delightful and information-crammed book called *The Versatile Soliton* by Alexandre T. Filippov¹. Filippov is a Russian theoretical physicist, a specialist in quantum field theory and high-energy physics. The first edition of this book was published in the Soviet Union in 1984, and then updated with a Russian publication in 1990. This new English-language edition was published in 2000, and Filippov says his "aim has been to reach a western audience." This column is, among other things, my attempt to help him do just that.

Don't let the fact that this book is translated from Russian put you off. Filippov was very careful in getting the translation right, and having the book "read" like an English-language book. Indeed, were it not for the obvious ethnic-

ity of his name and the voluminous quotes from Russian authors, one could easily read Filippov's book without ever thinking that it had originally been written in anything other than English.

The solitary wave of John Scott Russell is a kind of soliton. Years after first seeing it at the canal, Russell would have this to say about that day: "[The solitary wave] is a most beautiful and extraordinary phenomenon: the first day I saw it was the happiest day of my life. Nobody had ever had the good fortune to see it before or, at all events, to know what it meant."

Today, solitons have been turning up everywhere and are studied in biology, meteorology, superfluids, condensed matter physics, astrophysics, and most exciting for me, elementary particle physics. Those of you who remember my column "Aether One or the Other" (March, 2000) will understand why I find that exciting. For those of you who don't remember it, sit tight and keep reading.

To understand Russell's wave and solitons in general, one needs to have a passing understanding of the difference between *linear* and *nonlinear* oscillations. Filippov explains this on page X of the introduction: "Characteristic properties of any linear oscillation are: (1) that its period is independent of the amplitude; (2) that the sum of two linear oscillations is also a linear oscillation; and (3) that small amplitude oscillations are linear. Linear waves have similar properties: (1) the shape and velocity of a linear wave are independent of its amplitude; (2) the sum of two linear waves is also a linear wave; and (3) small amplitude waves are linear. Large amplitude waves may become nonlinear, which means that these simple rules do not apply." (Engineer and physics types will recognize that number 2 is simply the law of superposition.)

One aspect of nonlinearity of waves which can be seen on any trip to the beach are the whitecaps that happen on

incoming waves. In the case of Russell's wave, the nonlinearities in the wave tend to make it steeper while the dispersive characteristics tend to flatten it out. The result is a wave that lives between these two forces, and thus, it persists.

Although Russell was very lucky to see his wave when he did, one shouldn't get the impression that there's anything particularly unusual about solitary waves. Indeed, as noted above, Russell himself had worked out the formula for the production of solitary waves in canals. When the right conditions are met, solitary waves and solitons are created every time.

In "Aether One or the Other," I mentioned that electrodynamics has much in common with hydrodynamics, particularly with respect to vortex filaments, also called line vortices. The vortex is a kind of soliton, and like ordinary waves in water, vortices dissipate. However, Helmholtz proved that vortices in a mathematically perfect fluid can be neither created nor destroyed—they last forever. He also showed that vortices can only terminate on an interface between the liquid and, say, the surface of a pool, or they have to form closed structures, like smoke rings. These facts led Lord Kelvin to try to make "atoms" out of structures in the aether, the prime candidates being solitonic beasts called vortex knots. (Note: A simple ring shape isn't stable since it either blows up or shrinks. However, *knotted* rings have the characteristic that some parts repel each other while other parts attract, so these can be stable. The simplest stable form is the trefoil knot, which looks something like a three-leaf clover.)

Filippov has an ample section of his book covering Kelvin's work and that which led up to it. Indeed, it was because of my interest in vortex knots that I went looking for a book on solitons in the first place, and was lucky enough to find this one. It may seem strange to those of you who were taught (incor-

rectly) that the aether died with relativity, but work on Kelvin's vortex atoms (or rather, vortex subatomic particles) continues today. However, there being little pay available for people working on aether mechanics, the work goes on in disguise.

I was delighted to find in Chapter 8, "Modern Solitons," that Filippov mentions a paper by Faddeev and Niemi that appeared in *Nature* (vol. 387, 1 May 1997) called "Stable knot-like structures in classical field theory." Therein, the authors announce "a numerical proof of the existence and stability of knotted solitons" (Filippov, p.229). This paper is aether physics under an assumed name. Niemi has another paper², a favorite of mine, in which he boldly declares: "Thus the numerical study of knots and the realization of Kelvin's dream appears to finally become a reality."

Of course, if particles are really vortex knots in a perfect fluid aether, we might expect that particlelike behavior would show up in the closest analogs we have to perfect fluids, the superfluids, the most familiar being superfluid helium. Does this happen? In the book *Exotic Properties of Superfluid Helium 3* by G. E. Volovik³, we are told (quoting this tantalizing tidbit from the description of the book at the publisher's website): "Some of the objects and physical phenomena in ³He have strong analogy with the neutrino, W-bosons, weak interactions, gravity, chiral anomaly, Quantum Hall Effect and fractional statistics."

In short, *yes!*

But superfluid helium is made of helium atoms. Of what is the aether made?

I don't know and I really don't care; that question can be left to the future. But can I describe accurately all those phenomena in the physical Universe that I do want to explain, like protons (and neutrinos, electricity, quantum mechanics . . .), in terms of solitonic structures *made out of* aether, vibrating, moving, and interacting with each other? If so, then I have only *one* substance

I have to accept as a given.

Conventional physics doesn't escape the "What is it made of?" question, either—it's just a question seldom asked. Are quarks made of the same "stuff" as electrons? How about neutrinos? Photons? Virtual particles? If we go along with string theory, of what are the strings made? How many different substances are we talking about?

In aether mechanics, everything is reduced to one substance—aether—and particles are dynamic entities made of knotted vortices in the aetheric fluid, and forces are manifestations of motions in that fluid.

In my opinion, for those pursuing the Theory of Everything, the wave of the future is solitary. ■

References

¹ *The Versatile Soliton* by Alexandre T. Filippov. Birkhauser Boston, c/o Springer-Verlag, New York, 2000. 261 pages. ISBN 0-8176-3635-8

² Antti J. Niemi, "Hamiltonian Approach to Knotted Solitons." This forms chapter 15 of the book *Ideal Knots* by Stasiak, Katritch, and Kauffman, eds. World Scientific, Singapore, 1998. 424 pages. ISBN 981-02-3530-5 (<http://www.wspc.com.sg/books/mathematics/3843.html>)

³ *Exotic Properties of Superfluid Helium 3* by G. E. Volovik. World Scientific, Singapore, 1992. 232 pages. ISBN 981-02-0705-0 (<http://www.wspc.com.sg/books/physics/1439.html>)

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Sometimes two problems can solve each other. . . .

The Trouble With Grampa

Arlan Andrews, Sr.

The trouble with Grampa is, he's dead.

He and Gramma died today and went to Heaven together and left us all behind. I don't know where Heaven is, except it's up in the sky.

I miss them. I loved Grampa and Gramma; they were a lot of fun and took me places and played with me and made me laugh. Now they are gone forever. I don't know why they left me.

But Uncle Ryan says he will explain it all to me tonight.

I hope he does. I am very sad. I am only seven years old and I don't understand *dead*.

The funeral service took place inside the auditorium of a large suburban church on the east coast of Florida, a subdued but still opulent and mostly transparent buckytube edifice replete with the latest technologies of the year 2025. Flanked by life-sized holostills of the two small, elderly, gray-haired people of whom he would speak, the minister raised his head to preach to the assemblage of mourners. "I welcome all of you," he said, standing behind his pulpit. "We are here for the last memorial to this loving couple, who chose to leave this world: a loving father, grandfather,

and great-grandfather, and a loving mother, grandmother, and great-grandmother. Having lived out their lives as they wished, having seen their descendants grow and prosper, they made their mutual decision to depart from us all—together, forever."

In the congregation of several dozen somber relatives, some fought back tears, others just shook their heads. Unhappy murmurings suffused the group. "Why couldn't they wait?" "They didn't have to end it *this* way." Arrays of the church's microcameras scanned the preacher, the audience, and the lifelike images of the elderly couple, transmitting the memorial services around the world to other family members and friends who were attending electronically, plus a few million interested or at least voyeuristic webbies.

As the minister spoke, all of the church's inner walls blazed with recorded images of the old people's lives, from modern 3D-VR imagery, to snippets of old-time family DVD videos and even scratchy flatfilm images, scenes dancing across multiply-tiled displays, a kaleidoscope of pictures reviewing the long lives of the couple, their triumphs and tragedies, their travels and travails.

In a forgiving but world-weary voice-

over, the clergyman briefly summarized the lives of the two loved ones. "Happy they were for many years, as you all knew. Sad they were, sometimes, as families broke apart and were alienated; soberly they watched as their grandchildren went to war, happy as they all returned. Grateful they were for the reconciliations. And especially for the newest generation."

He ended the services with a five-minute sermon on the effects of life's choices on those left behind. "I need not repeat to you all here today that some choices in life bring continued happiness, while others bring confusion and doubt and pain. It has always been thus in human affairs, but in our faith we have the absolutely certain knowledge of resurrection and life in a better place. Let us pray."

"At least the service was short and to the point," Ryan, the eldest grandson, said to the group assembled around the dining table in his elegant beach house. His private jump-jet fleet had flown most of them here, but two of his cousins were present via 3D-VR only, background images of dark space scenes from High Hong Kong contrasting with brightly-lit mining operations somewhere in the Republic of Alaskiberia. "I don't think Grandpa and Grandma would have wanted it long and drawn out." The other nine grandchildren concurred. After the services, Grandpa and Grandma's six children, now approaching elderly life themselves, were convening together at a nearby seaside hotel to console each other, while these, their ten grandchildren and sigs were meeting at one of Ryan's several homes, a luxury ClearWall estate on Cocoa Beach.

Outside on the bright white sand, a gaggle of great-grandchildren of varying ages, from toddlers to teenagers, were choosing up sides and sorting out the latest multi-*verch* games. Some of their holocostumes were outrageous, Ryan thought, and it amused him to watch

through transparent walls and see giant Vikings doing battle with purple sea-serpents emerging from the surf. Some of Cousin Alex's holoproducts were really *fun* to watch. At least most of the kids were enjoying themselves, not yet truly aware that the elders of their family were gone for good. Except for little Andrei, the one who sat under the palm tree, staring at the sky. Ryan sighed, not looking forward to the task he had to perform tonight: He had promised Andrei to explain all about death, and why Grandpa and Grandma would not be returning.

"I still don't understand it," the VR-image of Senator Addison Kirby said, the New Capitol Building visible in the background, overarched by Pike's Peak and the long blue snow-capped wall of the Rockies. "They were only in their eighties; couldn't they have taken some rejuve treatments and had more years here with all of us? The costs would have been borne by Consensual Security." He sighed, "With my political contacts, I could have ensured their priority in the queue. I sometimes think they were just too selfish, going out like this."

Cousin Silk, the nangeneer, quickly broke in from her office in High Hong Kong. "Yes, but the rejuve treatments are still too primitive, and they would have stayed the same apparent age. Who wants to stay eighty years old for twenty more years?"

"And there's a danger that the current processes might make them immune to the ones that we see coming along in a few years. My nanossociates tell me that fairly soon they might be able to stop all aging, forever. So we just have to wait a while longer."

"But they couldn't take that chance, not at their age," Ryan said softly.

Sarah K., a Web-renowned cyber-sculptor, nodded her head in agreement. "Right, why would they have wanted to chance it and stick around for a few more decades, still in elderly bodies, and perhaps cut themselves out of

the chance for true immortality? Or died in the meantime?" She shrugged. "You all knew them; they enjoyed gambling, but theirs was a choice I myself would find hard to make. At least most of us here can wait until our fifties to face that decision."

Alex couldn't take it any more. "Damn it, cousins!" he shouted, "And Liz, Ian," that, quietly, nodding toward the end of the table, "We all *know* why we're here mourning when we should be happy for them! It's because we are *jealous*. They are gone forever, to a happier place, while we will stay here and grow old." His cousins and siblings smiled; there was that famous spec-fi game-writer's angst again.

"So what if we *can* get permanently rejuvenated in twenty or thirty years? What if we *can* live forever?" Sarah K. paused, pointing through the transparent Clear-Wall toward the sky. "*They* will be up there, always. But *we* won't ever want to go. What if we cheat ourselves out of a better world than we know?"

Hours later, near midnight, the grandchildren were alone at the large table, their sighs long since tired of the soul-wrenching arguments and recriminations, long since retired to the many bedrooms. The older great-grandkids were back outside on the beach, taking advantage of the soft summer moonlit night and playing glow-ball games. Only little Andrei had stayed up, Ryan noted, still leaning against his palm tree, still staring at the sky. *So serious for a seven-year-old!*

"So it boils down to this: Right now, rejuve technology is still in its infancy," Ryan said. "You take some quick treatments, stay at your apparent age for a decade or two at most, then die." His sisters and cousins nodded.

The senator chimed in, "But if you go into a rejuve chamber, under total suspension, then the techies can actually reverse the aging process, right?" Solar power satellites, glowing like miniature

moons, silhouetted the Rocky Mountains behind his image.

"That takes so *long*," Sarah K. came back. "You'd have to stay in suspended animation in a chamber ten years to drive your final apparent age back only ten."

"Right," Lauren spoke up, "The latest approved rejuve process—the one we're using now—still takes one year in the tanks to come out one year younger than when you started, but things are improving. Only twelve months ago, you needed *two* years in the tank to get one year younger. Someday it may get a lot better, but we can't know that yet."

Alex said, "So, Lauren, at the moment, the best your nanodocs could have done for Grandpa and Grandma, to take them from their real age of eighty-five years old back to a physiological age of thirty years, would require them spending fifty-five years knocked out in a treatment chamber?"

"Correct, Cousin. And nobody would want to do that—the world would change too much, and all the family relationships would be screwed up. They might not even want to exist in the world of fifty-five years from now. That's why they made the choice to end their lives here. Let's have our cousin here do the details." But before the family's AstroSosh could speak, some of the older great-grandkids came in from the beach games, shouting. "It's time, everybody. It's time to see the show!"

Ryan, noting that Andrei still sat alone, soberly assessing the situation with seven-year seriousness, motioned for Andrei's mother to go be with her sad son.

Two generations stood on the moonlit, midnight sands of Cocoa Beach, watching toward the north. An immense orange flare suddenly blossomed on the dark distant horizon, followed by a glowing column of cloud like a moving finger writing large and bright upwards across the sky, a luminous plume reaching for the heavens. As the bright

vertical streak faded away to darkness, a dozen laser-launch green beams stabbed the night sky, their ribbed, conical array converging to push a tiny bright speck on up and out of sight. Some on the beach cheered—at least the kids did. Some of the adults shook their heads; a few people cried and turned back toward the shelter of the condo, unable to watch any more, unable to understand.

Little Andrei, now standing in awe of the spectacular launch, held onto his mother's hand very tightly, big tears in his eyes. He didn't understand any of this.

Ryan looked over at him, meeting his nephew's pleading gaze, and knew he was chosen to be the male component of the *ad hoc* family. He had to comfort the boy.

"Nothing lives forever, Andrei," Uncle Ryan told me. We were sitting at a big table, with Uncle Alex and Aunt Lauren and Aunt Sarah and Aunt Kristen and both Uncle Ians and my mom. Aunt Silk and Uncle Kirby were there, too, in their funny VR tubes. Everybody was looking at Uncle Ryan and me. "Everything lives out a life-span, and then everything dies." He looked me right in the eyes when he said that, so I knew he was telling me the truth, but I didn't know what he meant. "Do you remember your white mouse?"

"Yes, sir, Uncle Ryan," I said, "I remember Mikkie." I remembered being very sad when Mikkie stopped moving a long time ago, and Mom said we had to put him in a little box and bury him in the flower garden planter. Maybe *dead* means being buried in a little box in the planter? I didn't see how Grampa and Gramma could fit in a box in a planter, and the idea scared me. I bit my lip and tears came to my eyes.

Uncle Ryan kept talking to me. "Andrei, Mikkie is dead, because after a while, like a machine, the body wears out. Like some of your microtoy robots and dolls."

"So they just need new batteries?" Maybe there was hope for Grampa and Gramma!

Uncle Ryan looked at me funny. "No," he said, "until now, all the way from the cave-person days, people's bodies wore out and when they couldn't function any more, they stopped. That is what we call *death*."

I didn't know what he meant. Uncle Ryan knew I didn't know, and he acted like he might be angry with me. "Remember their hair, changing to white?" No, it was always white to me. He rubbed his hands and put all of his fingers together like he was real nervous or something.

"Grandpa once had dark brown hair, like mine," he said real slowly, "and Gramma had bright red hair, like Aunt Silk's." I laughed at that. I didn't believe him.

"And once, their skin was as smooth as yours." I looked at my arms. But Grampa and Gramma had lots of loose skin, with blue streaks and lots of wrinkles.

"And they used to be able to run almost as fast as Aunt Silk." But *nobody* could run that fast. She was a running champion of some kind—she was on VR a lot. Grampa and Gramma kind of hobbled around, real slow, and always hurt a lot, they said. I remembered that, but I didn't say anything.

"So, Andrei, you see that people's bodies wear out, then their hearts stop working, and that is *death*."

I understood what he was saying at last, and I began crying again. "Then they are gone away. You put them in boxes and put them in the dirt?"

Uncle Ryan sighed and looked at my aunts and uncles and my mom and shook his head.

"You mentioned new batteries, Andrei?" I nodded.

"Well, in a way, Grandpa and Gramma have some new batteries, but it is going to take a long time for them to charge up."

I was happy! "I can see them again, when they're charged up again?"

"No, I'm afraid not," Uncle Ryan said. "It is going to take them a very, very long time to get 'charged up' again. And they will be a long way from here when that happens."

I guess I really didn't understand *dead* after all, and I didn't understand anything he was saying now. I just wanted to see my grampa and gramma again, while they were recharging. I was about to start crying when he wagged a finger at me. I stopped.

"Andrei, the lightship we saw launched tonight will sail for fifty-five years to a star that is called Alpha Centauri."

I understood going to the stars. I had seen lots telescope pictures on the VR of the planets of Alfie Sentry—of that star. They looked like little blue and white and green balls and my Mom had said people could live on them some day, according to the instruments. "Can I go see it, outside, now, Uncle Ryan? Maybe I can see Grampa and Gramma up there? With a telescope?"

"No, not tonight, but later, I promise I will take you to a place where you can look up and see that star." He smiled at me, I guess happy with me 'cause I knew stars. But I really wasn't sure why Grampa and Gramma would go away without me.

"Andrei, Grandpa and Grandma are in rejuvenation chambers on that lightship, and they are traveling toward Alpha

Centauri at 8 percent of lightspeed. They are being made younger by that rejuvenation process, and they will be sleeping all the way through it. By the time they arrive, fifty-five years from now, they will be the same age as your Aunt Sarah and your Aunt Lauren and your Uncle Alex are now: thirty years old." I was trying to understand, but it was too hard. So I just smiled and nodded, and Uncle Ryan was happy at last. The way Mom always is when I do that. I do that a lot.

Aunt Sarah came over and hugged me, with tears in her eyes. "Andrei, we are so happy you understand what is happening. Your grampa and gramma will wake up orbiting a new world. They will be young and have a whole new life ahead of them."

"Is that new world Heaven?" I asked. All my aunts and uncles started crying and got up and began hugging each other.

Aunt Lauren just looked at me and said, "Yes, Andrei, I think it will be called Heaven."

At last I knew what Uncle Ryan meant. I jumped up from the table, laughing. I ran outside and started singing all the songs I knew, pointing at the magical stars, waving at Grampa and Gramma. Maybe they could see me down here, someday.

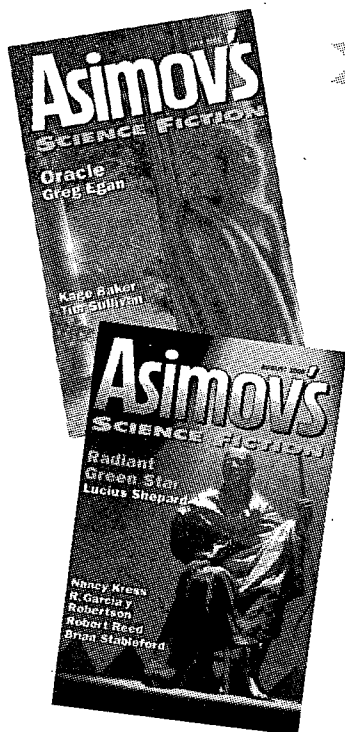
At last I *really* understood. From all the fairy tales, I knew about sleeping for a long time and waking up in a magical place.

I still don't know what *dead* is, but I do understand *magic*. ■

It is better that some should be unhappy than that none should be happy, which would be the case in a general state of equality.

—Samuel Johnson

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Selements and Beyond

Shane Tourtellotte

In the November 2001 issue of *Analog*, the late Poul Anderson pioneered the analysis of selements, created by adding an initial "S" to members of the periodic table. Further advances in this field have come slowly, primarily because Poul took all the easy ones, but hard work has succeeded in expanding the bounds of schemical knowledge. Below I present a further table of the sproperties of

SELEMENTS

samericum: Plays it again.

sastatine: Talks back to lace-makers.

sberyllium: Found on cowboy boots.

sbohrium: Expelled from mushrooms.

schromium: Found at rugby games.

scurium: Hasty.

sdubnium: Causes toe injuries.

seinsteinium: Covers beer mugs with runes.

seuropium: Narcotic; grown beneath Paris.

sgadolium: Abundantly tiled.

sgallium: Long and oniony.

sgold: Reproachful.

shahnium: Backs up Bowser.

siridium: Makes a noble turn of phrase.

slawrencium: Shredded.

smeitnerium: Hard-hitting.

smolybdenum: Levi's-clad and supporting autonomy for Smolensk.

sneon: Cutting.

snobelium: Rides across winter landscapes.

spraseodymium: Creates a shower of gems.

srhodium: Displays Beethoven's bust atop a piano.

stantalum: Holds open blood vessels.

stitanium: Contains sunbathing pigs.

sytterbium: Reclines in large cities.

syttrium: Fruity yet acidic.

Science is an interdisciplinary field: knowledge in one area enhances understanding in others. To understand the elements, one should know about what makes them up. This list is nowhere near exhaustive, but will provide a basic knowledge of

SELEMENTARY SPARTICLES

sbaryon: Common in Italian fast food.

selectron: Choosy.

slepton: Causes cricks in the neck.

smuon: Native to Dogpatch.

sneutron: Not much. What's sneu with you?

sproton: Garnished with alfalfa, in Canada.

squark: Issues from a very small crow.

stachyon: Creates vertical sequences.

The previous lists have described qualities, but assessing quantity also has its place in science. Most of the world utilizes the metric system, but we Americans still cling, smirkingly, to the Imperial system. To reach the broadest audience, I have included both in this partial list of

SMEASURES

sacre: Unit of holiness, 1/109th as blessed as Vatican City.

sampere: Unit of force, equivalent to a Pete Sampras serve.

scarat: Unit of fright; based on engagement ring sticker shock.

sgram: Unit of velocity when cheived from behind. Maintaining one thousand times this speed shows great talent; hence, **skilogram**. Conversely, moving at one-hundredth this speed plainly stinks; hence, **scentigram**.

sinch: Unit of tightness, equivalent to one belt notch.

sliter: Unit of narrowness.

smile: Unit of angle; measures curvature of the mouth.

smiss: Unit of angle. As good as a smile.

squart: Unit of flexibility; measures ability to bend at the knees.

ston: Unit of astonishment, equivalent to being hit with 2000 pounds of bricks.

stroy ounce: Unit of weight used in explosives.

swatt: Unit of force sufficient to kill one standard housefly. 859 swatts = 1 sampere. ■

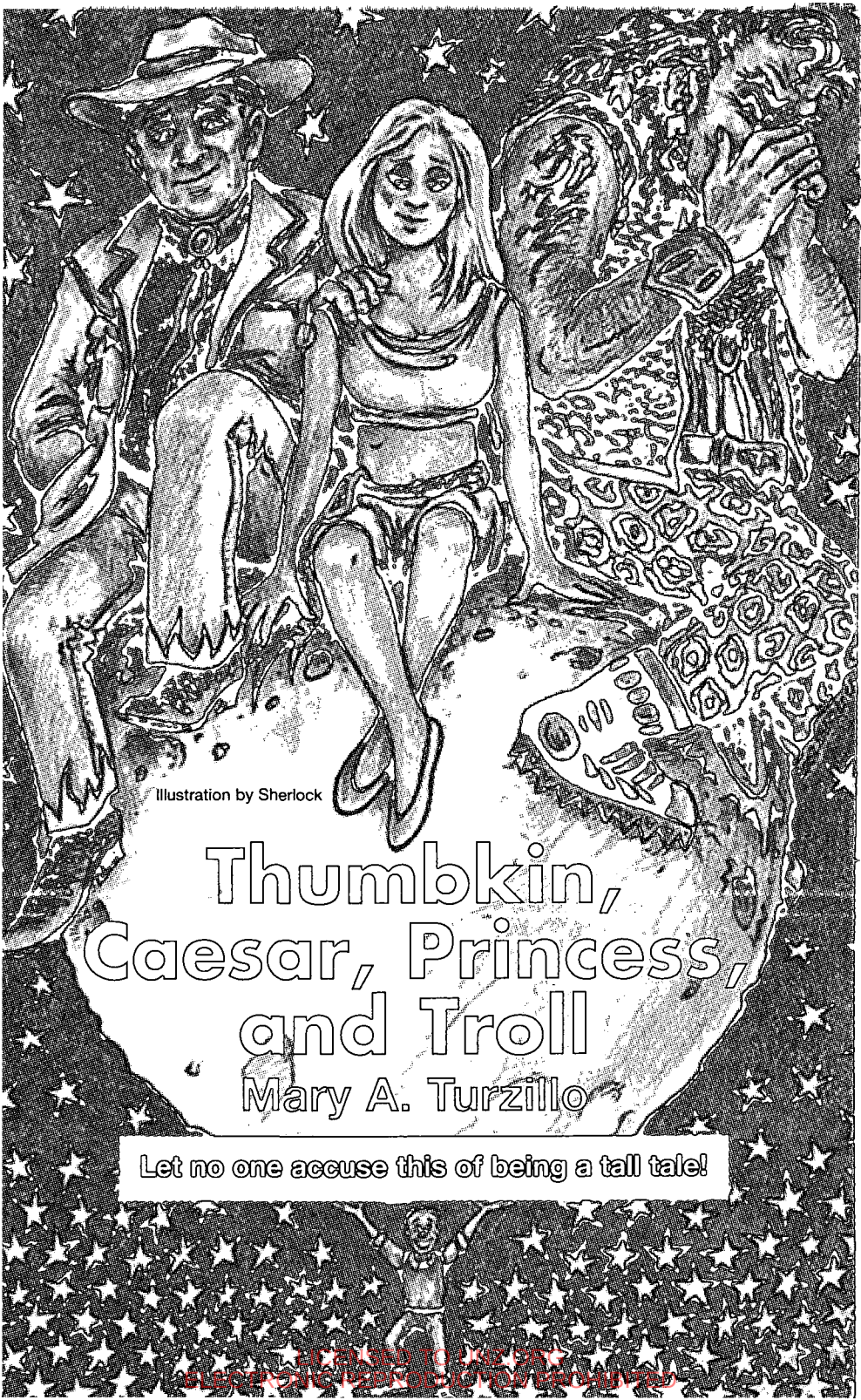


Illustration by Sherlock

Thumbkin, Caesar, Princess, and Troll

Mary A. Turzillo

Let no one accuse this of being a tall tale!

REPRODUCED TO THE BEST OF
THE PUBLISHER'S KNOWLEDGE

Thomas Maximilian Abraham Augustus Grand yearned for a woman who could hold him in the palm of her hand. No lesser consort would fulfill his dreams. His twelve centimeters would complement her meter and three quarters.

Thomas Grand, or Thumbkin, as the media later called him, was a man born before his time. His parents, Doctors Pete and Polly Grand, had wanted an astronaut's career for their son, and so conspired to conceive a baby who, at maturity, would stand only twelve centimeters tall. Future space missions, they believed, would be crewed by people who massed less than two hundred grams.

Thumbkin exceeded expectations. His body had matured fast, with fewer cell divisions, hence fewer total cells. Thanks to clever genetic engineering, a far greater proportion of his brain could be devoted to higher cognitive skills—symbol manipulation and spatial perception. And a smaller, more neotenous brain enhanced his synaptic firing speed—a determinant of intelligence.

But shortly after Thumbkin's twelfth birthday, public opinion turned Luddite; factory workers overran and trashed nanotech labs. In such a climate, Congress cut space and science funding to the bone. Further, existing astronauts formed unions and fought the genetic engineering of the mouse-sized astronauts who might spoil their own chances at the planets.

They only succeeded in destroying the space program. Little guys like Tom Grand would have been affordable crew on a mission to Mars; the big guys spoiled it for everybody.

Truth was, Thumbkin didn't much want to be an astronaut. He preferred inner space—the submolecular world.

True, nanotechnology had a really bum rap, hysteria spilling over from the furor over genetically modified foods. But, following his own dream, Thumbkin enrolled in one of the rare nan-

otech Ph.D. programs still left in the country, at Buckeye State. His own condition was not due to nanotechnology, but a simple in-utero hormone treatment. He was lucky; his only deformities were an outsized nose, disproportionally large feet, and genitalia to match. Of the last, he never really could conduct a comparison, since he was the only man of his height in the Midwest, although several others lived in California, and one or two in east Asia.

In the lab at Buckeye, he had his problems. He always had to get his partner to lift him up to the computer or the lab table, though he petitioned for a ladder. Once level with the instruments, he scampered nimbly about, jumping from key to key to program the atomic force microscope. Once he was trapped in a chamber of self-replicating Penrose tiles, and saved his own life by hanging from the lid while the crazy quilt of polygons surged around his feet.

His professors had to read his exams with a microscope. They often tried to psychoanalyze him, saying he only went into nanotech because he'd otherwise never get to work with anything smaller than he was.

One sympathetic professor, a buxom brunette who inspired in Thumbkin a fantasy about tiptoeing along her low neckline and possibly burrowing in her cleavage, said he should try for a woman his own size. Ah, but those puny specimens (there was one finishing her master's in medieval French literature right there at Buckeye State) didn't get his juices flowing at all. He liked big women.

Several adventurous women did accept dates with him, but some embarrassing incident always sabotaged the relationship before it really blossomed. With Mindy, it was when they went to a movie and the ticket seller let them in on one ticket, not even noticing Thumbkin, who was standing on the floor beside Mindy. With Gretchen, there was that awful evening when Thumbkin

decked himself out in a Hawaiian shirt and perched on Gretchen's lapel, only to hear her mother compliment her on the cute new brooch.

In 2023, when Thumbkin was about to get his degree, the commencement speaker was a jovial billionaire named Harry P. Caesar, who had made a fortune in utilities, having speculated on fusion reactors just before they became feasible technology. Mr. Caesar made an audacious offer from the podium.

"Gentlemen, this is a time for boldness and forward thinking. Put aside the hand-wringing of the Luddites and solve three problems for me. The first man to give me answers to these burning issues will earn a controlling share of the stock in my company. Not only that, but I'll marry my daughter off to him."

A buzz of excitement rose from the graduating student body. One female graduate shouted, "What if a woman offers the answers?"

"I'll marry her myself!" crowed Caesar.

They settled back in their seats, waiting for the three problems.

"First," said Caesar, "is the problem of the slums of Great Lakes City. The poor shoot each other or die of drug overdoses. We need to give them a better life. Second, there is the problem of world hunger."

Students exchanged wary comments. Such problems were difficult, but perhaps the superior minds in the class of 2023 could overcome centuries of adversity. Caesar rapped on the podium.

"And third, my new Sebeliuswagen X-03 has a miss so bad it never reaches its peak acceleration."

Dismayed murmurs rippled through the hall. The Sibeliuswagen X-03, the most pretentious lemon ever built? Poverty and world hunger, sure, but the Sibeliuswagen?

Still, graduates swarmed up to Caesar after the ceremony. Thumbkin was able to attract his attention only by using a pair of straight pins as pitons and some buckminsterfullerene monofilament to

climb up his pant leg and suit jacket, after which he buttonholed the multimillionaire. In fact, he crawled up the inside of Caesar's lapel and stuck his head through the buttonhole.

"Listen," said Thumbkin. He had a high voice, it's true, but not as squeaky as you might think. After all, a blue jay is pretty small, and you know what kind of racket *they* make. "I can do all that. Just give me a chance."

"Hm," said Caesar. "I see you are graduating summa cum laude. And yet, I suspect your cuteness influenced your professors to give you high grades. If none of your classmates can solve these problems, I suppose I'll give you a chance."

It was completely unfair!

Thumbkin, discouraged, trudged back to his apartment, which was on the top of his best buddy's microwave oven, and followed the antics of his classmates as they tried to earn Caesar's reward.

Gumbon Carlsbad, the class cut-up, tried to reclaim the slums of Great Lakes City by using assemblers to change all the paving materials in the poorer neighborhoods to white chocolate. He apparently believed the endorphins would assuage the anger of the unemployed and disaffected. He then passed out fifty dollar bills made by other assemblers, ones which were programmed to give each bill a different serial number. His scheme would have worked, had Caesar not been a law-abiding man. Counterfeiting is still a crime.

Millicent Kratchett, who wanted to bed Caesar rather than marry his daughter, tried introducing a retrovirus which changed all the dope in northeast Ohio to vitamin B12. The ensuing riots were particularly difficult to control because all the participants were completely lucid and out-thought the police at every turn.

The local TV gods and goddesses sneered so hatefully at Millicent and Gumbon that no more candidates were willing to try their luck. This was Thumb-

bkin's cue.

He first put an ad in the paper calling for a collection of all firearms in the city. He promised these would be converted, by his assemblers, into televisions with free satellite links.

When the televisions were delivered (and they were very thin, elegant ones, massing no more than the guns they had been made from), they turned out to have free Internet connections, with special search engines which, when they opened X-rated sites or chain e-mail jokes, would artfully segue into instructional material.

"I don't know," said Caesar. "They seem happy, but let's see what you can do to solve world hunger."

This proved an easier task, although it took longer. Thumbkin created a fleet of self-replicating robots to deliver what he called Mother Cupboards to the poor of the world. The cupboards themselves were self-replicating, usually creating their mass from sand or rock. Then, as a third generation replicator, each Mother Cupboard was capable of converting whatever was on hand—dirt, weeds, used tires, discarded compact discs—to a beans-and-rice mix that looked and tasted like pizza. Problems arose when it was discovered that a bad LDL-HDL cholesterol ratio could result from the fact that the pizza lacked omega-3 oils, but by this time many young people of Great Lakes City had gotten advanced degrees in Replicator Programming as a result of their new Internet connections. They volunteered their services to add anchovies. And, by a clever feat of engineering, these were a new type of anchovies that didn't taste like anchovies.

Buckeye State had allowed Thumbkin laboratory space as a publicity stunt to make the public forget about Millicent and Gumbon's gaffes. Caesar came to him there one afternoon. Thumbkin knew he had the wealthy man in the palm of his hand (to use a ridiculous metaphor), because Caesar had come alone rather than having his secretary

call.

"There's the matter of my Sibeliuswagen X-03," Caesar said. "I can't find a local mechanic who knows what's wrong. They want me to send it back to Finland."

Thumbkin discovered the problem after only an hour of investigation.

Swinging himself out of the engine compartment on the alternator belt, he reported, "There's a family of mice living in the air intake manifold."

"Nonsense!" Caesar scoffed. "None of the other mechanics found mice."

"None of the other mechanics actually walked through the intake manifold. But there's another problem: your fuel supply."

"The fuel line is fine," said Caesar.

"Fuel *supply*. Tell you what. You need a loaner? I'll have to keep it overnight."

Caesar decided to take a cab when he realized the loaner was Thumbkin's hand-held bicycle.

Next day, Caesar returned to find Thumbkin crawling out of a strangely empty engine compartment.

"What have you done to my engine?" shrieked Caesar.

"Improved it. It now runs on hydrogen. I installed nanotubes to process the hydrogen, but you'll find it's fairly cheap, and a tank should last you about—oh, say 2000 kilometers."

Caesar jumped in the car and revved it up. Thumbkin rode on the dash, car-dancing to the music Caesar had on the sound system, "Dr. Mesmer's Spiritual Ferret" by Machine Embryo. Several miles later, Caesar said, "You did it! Well, let me write you a check."

"Not so fast," said Thumbkin. "You promised a controlling share of the stock in your company. And I have witnesses—everybody at that graduation."

Caesar harumphed. "Well, of course. I meant we can meet in my office tomorrow about noon and draw up the papers."

"*Not so fast*," Thumbkin continued. "There's the small matter of my future

bride."

"You can't mean Princess," groaned Caesar.

"The woman of my dreams. The mother of my future children."

"You realize she's a free woman. I was only joking when I said I'd marry her off to the winner of my contest."

"I was only joking when I said your car will continue to run," said Thumbkin. "When this tank runs down, you'll have to find the gas lid release, which I conveniently relocated."

Caesar sighed. "Well, she could do worse. Of course, I always wanted grandchildren, and you don't seem—"

"Don't tell me what I can and can't do," said Thumbkin.

Thumbkin soon learned why Caesar gave in so easily. Princess had been an idealistic, bright girl until she went wrong at age eighteen. Now she was heavily involved with a drug lord named Dick Troll.

Troll was a massive, ugly man who paradoxically exuded sexual magnetism. Standing over seven feet tall, he routinely provoked terror in his criminal lieutenants by barefistedly punching holes in the roofs of their cars, or hanging them by the back of their shirts on basketball hoops. Women, however, swooned over him. Princess, Caesar's sexy daughter, seemed to be one who had been swept up by his animal charm.

Thumbkin decided that he could best win Princess's regard by showing what a goon her lover was. He showed up in Troll's lavish, tastelessly decorated apartment unannounced. In fact, he simply crawled under the door.

"I've heard of you," Troll said. "You're the little chemistry major that Daddy Caesar wants my woman to hop in bed with. Never happen. Princess goes for big men."

The bigger they are, the harder they fall, thought Thumbkin. But he merely said, "I think Princess will go for a big brain rather than a big mouth."

"Haw. Your brain can't be much bigger than my little toe, now can it?"

"Doesn't matter," said Thumbkin. "Your brain is smaller than *my* little toe."

Troll had not had much opportunity in his short life to learn anger management, so he lifted his huge athletic shoe (size 23 triple D) and stomped down hard on Thumbkin—

—or rather on the place Thumbkin had been. The nerve impulse between Thumbkin's head and Thumbkin's feet was quite short, him being so small and all, so he was gone like the beam of light from a laser cat toy.

In fact, Troll had slammed his foot down on a fork Thumbkin had surreptitiously dragged in behind him, and the fork flew in the air and embedded itself in the bridge of Troll's nose.

Thumbkin thumbed his own tiny nose at Troll, and the mammoth drug lord dove after him. The tiny man led the giant on a wild goose chase around the posh apartment. A priceless lamp in the shape of Elvis exorcising a demon from Marilyn Monroe crashed into the plush sculpted carpet, burning a hole in the beautiful cabbage rose design. The chandelier, composed of dangling crystal Hummel knockoffs, crashed as Troll made a wild jump for Thumbkin, who was shinnying up the electrical cord. Troll slid through the door to the downstairs powder room and skidded only to slam his head into the porcelain toilet base.

Thumbkin perched on the purple crushed velvet commode cover and swung his legs. "Don't make me do this," he said. "Can't we fight over her like gentlemen?"

"A duel!" Troll roared.

"A drinking duel?" Thumbkin asked. He knew the answer. Troll's forte was in more deadly drugs than alcohol.

A half hour later, Thumbkin sat on the coffee table, which was surfaced with rose quartz inlaid with shark teeth. Troll sat on an orange flower-print leather

sofa. A hundred-dollar bill and a pile of pink powder rested between them. Tension was in the air.

"Pure Strawberry Lucid," said Troll. "The man who's left standing gets the babe."

"If she'll have me," said Thumbkin. He hated how tiny his voice sounded, and he had some ideas how to fix that if he won the lady and the stock.

"Haw!" barked Troll, and rolled up the bill. He laid a line of the designer drug on the table and gave the bill to Thumbkin.

Thumbkin staggered under the weight of the bill. He clasped both arms around it to keep it from unrolling. Then he laid it to the line and began to inhale.

Assemblers he had sprinkled on his upper lip went to work. They decomposed the organic compound of the drug into harmless gasses. The oxygen gave him a little kick, but other than that, he felt nothing but growing tension. Would his plan work?

Troll grimaced. "I have to hand it to you, shorty." He rolled another bill (which Thumbkin had counted on) and laid another line.

Thumbkin had a different kind of assembler ready and he dropped a pinch of them into the line while Troll closed his eyes waiting for the rush.

The drug and the assembler reached Troll's nose and began their transformation. His nose began to weave itself into a bright pink bungee cord. One end was stuck to his face, the other to the hideous coffee table.

"Mwat nave nou none?" roared Troll. He tried to yank himself away, dragging the coffee table around the room with his bungee-nose. He twisted and rolled this way and that, but his struggle only resulted in wrapping his nose around his neck three times. He clawed at his nose-necktie, bellowing like a boar.

Thumbkin, straining every muscle he had, lifted the phone off the hook and punched numbers.

"I don't know," said Princess. "I admit, seeing him like this kind of shoots down his sex appeal. But isn't this a pretty cruel fate, even if he is a rotten, no-good drug lord?"

"If you but say the word," said Thumbkin, "I will send other assemblers to repair his damaged nose and face. Maybe even improve them."

"You certainly strike a hard bargain," she said thoughtfully, bouncing Thumbkin on her palm. "I hardly know you. And you're—well—uh, not to my scale."

"Oh, if you want me to, I'll set him free no matter what your decision about dating me. Just say the word."

She looked relieved. "Well, that's big of you. Why don't you mail the repair assemblers to his secretary? That way he won't come after you."

"I'm not worried," said Thumbkin. "He tried that before."

She smiled and held her hand out so that Thumbkin could climb up on her shoulder. The two went to a nearby Mocha House and ordered a decaf iced café voltaire with cinnamon sprinkles, which turned out to be a favorite for both of them.

"I have to admit, I do admire your style," said Princess.

"And I yours. You had that big gorilla eating out of your hand, didn't you?"

"My father never understood," she said. "I thought I could save Dick Troll. I thought the love of a good woman would turn his harsh soul to goodness. I love a challenge."

Thumbkin dragged the sugar container over to their café voltaire to use as a step so he could dip out a portion in the thimble he always carried with him. "I love this stuff! If I ever go crazy, stop me from designing assemblers to turn Lake Erie into a sea of café voltaire!"

Princess gave him a serious look. "I'll keep that in mind."

"Listen to me," he said. "You don't have to make a commitment. I know I won that game with your father, and then I duelled with your monster lover.

ANALOG

But you do what you want. You're a free woman."

She sat back and settled her cashmere sweater around her shoulders. "Well, excuse me! It's really so darn flattering that you want me so much."

"I didn't mean that," said Thumbkin. "I want you more than anything in the world. Lord, Princess, I can have most anything I want. Haven't I proven that today? But what I want is you."

"You'll have to prove you really, really want me," said Princess.

Thumbkin's heart fell.

Another test.

"I want," she said, leaning forward so her hair draped like a silken curtain all around his body, "the Moon and Mars."

Thumbkin didn't like the sound of that.

She sat back. "Come on now. You're the master of nanotechnology, but maybe that's because it's been swept under the rug. It's only taught at backwater universities, because the labor unions don't want people to lose their stupid jobs."

He gulped. "True enough. I changed a little bit of the world. I wiped out crime in Great Lakes City. I abolished world hunger. I changed a gangster's nose into a bungee cord. But I can't change people's minds right here in northeast Ohio. They don't like nanotechnology."

"And that's why my father will never be able to set up shop on the Moon. I want the Moon. And Mars. And some other planets. For my father. For us. Space travel. Well?"

He sat down heavily on the edge of the sugar container. "Give me some time to think this over."

Thumbkin went back to his apartment on top of his friend's microwave. He watched the news on a wristwatch TV his mother had given him. He flipped through his graduate school textbooks. He had had them converted to electronic form because he couldn't manage the huge, heavy pages. He

thought back to his early childhood, when he first learned to use a computer. It wasn't easy, but he finally had learned a kind of touch-type tap-dance that accomplished what he needed. He used a touch screen instead of a mouse, and reclined the monitor so he could reach the icons he needed with a drinking straw.

For a week, Thumbkin surfed the web. And he surfed the pages of his own mind.

When the week was over, he went to Princess again.

"If you will be mother to my children, I will send them to the Moon, and probably beyond."

It was her turn to ask for time to think. "How can you promise me such a thing?"

"You either have faith in me, or you don't."

Princess and Thumbkin had a quiet wedding. Her father, Drs. Pete and Polly Grand, and a few friends from both sides.

I won't describe their wedding night. They were creative people, and since you, my reader, are also creative, I will leave such matters to your imagination.

Thumbkin was busy lobbying and petitioning, and also finding scientists to listen to his plans.

A year later, Thumbkin took Princess to dinner at Monaco's in the Flats. After the espresso and tiramisu, he carefully swept crumbs off the table by dragging a napkin across it. Then he brought a small green egg out of a suede bag he had carried in with him. "In here," he said, "is the future." He put it on the table.

She reached out for it, but he said, "I'll roll it over to you, but be very careful. Inside are our children."

She drew back, then as if by an act of will, took the egg. "You have done this without my permission. You've taken our DNA, mine and yours—but without telling me—"

He bent his head sorrowfully. "I did

not truly trick you. You promised we could have children. In this egg, a thousand children are growing. Nanomachines feed and rock them. Our images are projected into their minds." He didn't mention that the children were so small their eyes perceived images in blue and shades of ultraviolet. Princess would figure that out soon enough. Now, the revelation of their existence was enough.

She touched the egg. "A thousand?"

"A thousand and twenty-four. We must name them. We must find ways to communicate with them. We must teach them and provide the best education possible." He reached out and grasped her index finger, hugging it to his breast. "We must love them."

"Astronauts," she said. "But how can they go to the Moon? How can they operate a space vehicle? How can they live in a space habitat?"

"We will teach them to control the assemblers and the manipulators," Thumbkin said.

Princess held the egg in her hand, and suddenly Thumbkin was afraid for it. She could crush it, and he couldn't stop her.

But instead, she asked, "If I put it next

to my heart, will the heat of my body harm them?"

He smiled, relieved. "The egg converts heat to energy for the nanomachines that tend them. You could put it in a fire and they would thrive."

She kissed the egg, and put it in the bosom of her low-cut dress. "Safe, for the time, then. You've been busy."

"Our children are so small, they don't need space agencies. We can build a ship for them ourselves."

"With Daddy's money?"

He shrugged. "Partly. But also from other investors with admiration for an audacious plan."

"When?"

"Not immediately. The children will grow fast, but they won't be ready for several years. In the meantime, we must educate them."

"You promised *me* the Moon and Mars," she said.

He squeezed her index finger, then climbed onto the cuff of her velvet jacket. "Have I failed your test, then?"

She thought for a minute, but she knew the true answer. "No. No, I guess not. My children will go to the stars. I guess that's enough."

"They will write home," he said. ■

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In Her Image

Michael A. Burstein

Many are haunted by the mistakes of their youth, but few quite so literally.



W'm afraid we've already lost," Ray Stebbins says.

Jacqueline LaRue stares at her lawyer for a moment. His large desk looms between them, intimidating her as always.

"What about the appeal?" she finally asks. "Aren't you planning an appeal?"

Her lawyer leans back and sighs. "I don't think we have a chance on the appeal," he replies. "Evercom's got this thing sewn up backwards and forwards."

Incensed, Jacqueline grabs her cane and bangs it once on the floor. "Ray, I don't pay you to tell me we've lost. We have a right to appeal the decision, and I want to do so."

He blinks. "Ms. LaRue, you *do* know that the California legal system has changed a lot since you signed that contract sixty years ago."

Jacqueline reaches for her handheld, which she keeps in her purse. Already on, it displays the text of the contract. "It says here that under any dispute, I'm entitled to appeal to a final arbiter."

"Yes, but—Ms. LaRue, on what grounds? I've already exhausted all of the arguments I could think of in our original case. Unless . . ." He pauses. "Unless you've changed your mind, and want me to argue that you weren't competent when you signed the contract."

Jacqueline bristles. "I'm having enough trouble with Milton questioning my competency now. I don't want to give the courts the idea that I wasn't competent then either."

Stebbins sighs. "Very well, Ms. LaRue. I'll try to come up with something."

A few days later, Jacqueline LaRue sits at the plaintiff's table in the same Los Angeles courtroom where she lost her initial case. The arbiter, an extremely young man clothed in the traditional black robes, sits behind the high bench, reading over Jacqueline's appeal. A paunchy bailiff stands nearby, looking straight ahead, his arms resting at his sides. Jacqueline knows that behind her,

spectators fill the room, the penalty of bringing suit in the crowded megacity. It feels as if every eye in Hollywood is upon her, boring into her neck. Slowly, her relaxation exercises fail, and, filled with apprehension, she starts drumming her fingers quietly upon the oak surface.

Her son Milton seems to notice the sudden change in Jacqueline's mood. He stops fiddling with the knot in his tie and leans towards her. "Mom, are you feeling all right?"

She swallows and nods. On her other side, Ray Stebbins glares at Milton. "Ms. LaRue," he whispers, "please tell your son to be quiet. We can't afford to disturb the arbiter."

Jacqueline nods and looks at Milton, who settles back into his seat, a blank expression on his face. A moment later, he takes her withered hand in his and squeezes it. Jacqueline nods again, grateful for her son's support, but annoyed with herself at needing it so much.

The arbiter looks up from his handheld and speaks. "Mr. Stebbins."

Jacqueline's lawyer stands at attention. "Yes, Your Honor."

The arbiter waves his handheld. "I've read over your appeal, and I have to admit that I can't find anything new in here to change the lower court's decision. Is there anything you wish to add?"

Stebbins glances at Jacqueline and mouths the words, "It's okay." Aloud, he says, "Your Honor, with all due respect, there is something new in the appeal. Did you read the fifth section of the document?"

The arbiter fiddles with his handheld momentarily and nods. "Yes, counselor, I did. And I'm afraid that the precedent you cite is irrelevant."

"But, sir, copyright law—"

"—states that rights to a work expire after seventy years. Yes, I know. But that statute does not apply to avatars."

Stebbins glances at Jacqueline. He had told her that this strategy might not work, so she is not surprised at the arbiter's comment. Disappointed, per-

haps, but not surprised. Still, her lawyer presses on.

"Your Honor, my client signed the contract the year before the revision of copyright and trademark law that protects avatars in perpetuity. By the laws of the time, her avatar must revert back to her."

"Counselor, even if this court were to agree, the full seventy years have not yet passed. The license on Ms. LaRue's avatar would continue for some time to come. And the contract does allow Evercom an option to renew the license." The arbiter lifts his handheld. "Your appeal does not seem substantially different from your original case. Unless you can cite another precedent to back you up, I don't see how you can possibly win this appeal."

Stebbins glances at Jacqueline, and she can tell from the look in his eyes that he agrees with the arbiter. "Ms. LaRue," he says softly, so the arbiter cannot hear, "I think it's time to give up."

"Never," she says. She props herself up with her cane, surprising the spectators into sudden murmuring. "I'll just tell it my own way."

"Mom, what are you doing?" Milton asks.

"Ms. LaRue," Stebbins says, "I really must advise against this."

"What possible harm can it do?" she asks. Stebbins looks thoughtful for a moment, then sits down.

Milton tugs at her sleeve. "Mom, listen to Mr. Stebbins. That's what we're paying him for."

She pulls her arm out of her son's grip. "When I want your opinion," she retorts, "I will ask for it."

"Ms. LaRue?" the arbiter asks. "Do you have something you wish to say?"

Jacqueline smoothes down her wrinkled blue-and-white dress and then looks up. "Your Honor, may I address the court?"

The arbiter nods. "You have that right."

"Thank you." Jacqueline looks around for a moment, then stares directly at the

arbiter. "Your Honor, look at me. I'm an old woman of eighty-two. Sixty years ago, as the Screen Actors Guild was going through its period of falling apart before it recouped, I made a mistake. I was young, impressionable, and naïve—I admit it. But I was not alone. A generation of us were pushed to license our avatars away to the major studios. They promised us fame and fortune with a minimum of work. It was hard to resist, what with the recession."

"The recession to which you refer is long past, Ms. LaRue. Why did you not take legal action immediately afterwards?"

Stebbins jumps up. "Objection, Your Honor. Your question is irrelevant to these proceedings."

Jacqueline gives the arbiter a tight smile. "My lawyer has advised me not to discuss it," she says, and Stebbins sits down again.

"I'm just curious, Ms. LaRue. But your lawyer is quite correct. The question was out of line, and I apologize."

"I didn't mind, Your Honor. And the fact is, my contract has been bought and sold so many times over the past sixty years that I was never quite sure who owned me in the first place."

"You mean, who owned your avatar."

Jacqueline shakes her head slowly. "No, Your Honor, and that's exactly my point. Evercom doesn't simply own my image. They effectively own me." She sighs. "They have my avatar acting in films I would never have agreed to, had I known. I'm an old-fashioned woman, Your Honor. Have you seen some of the trash they've made?"

The arbiter shrugs, which looks peculiar to Jacqueline, given the way it moves his black robes. "Ms. LaRue, I sympathize with your plight, but the law is the law. I've read the contract you signed with Malone Studios back in 2010. There's no legal recourse. If you could show that they had violated your contract—"

"What about the nudity clause?" she says, and the spectators gasp at Jacque-

line's interruption.

One of the five lawyers from the other side jumps to her feet. "Objection, Your Honor. Evercom has not violated the nudity clause."

Stebbins leans over to Jacqueline. "I've already told you that this wouldn't work."

Ignoring him, she says, "They took the scans of my body and created a nude image, Your Honor, one I never authorized. I can give you a list of five films produced by Evercom in which my avatar has appeared naked."

The arbiter nods. "I've seen the list, Ms. LaRue, and I'm afraid you have no legal standing. The extrapolation clause clearly allows Evercom to use your scans in any way they see necessary."

Jacqueline sighs. "That was for motion capture, Your Honor. The scans were made to allow them to show me in motion, not to show me unclothed."

"The lower court didn't read it that way. And I'm afraid I don't either." He pauses. "Do you have anything else you care to add?"

Jacqueline shakes her head. "No, Your Honor," she says. She remains standing.

The arbiter nods and looks at the Evercom table. "Does Evercom have anything they wish to say?"

The five Evercom lawyers huddle for a moment, and then the head lawyer replies, "No."

"Very well. I declare in favor of the defendant." The arbiter swings his gavel down, and the crack of the impact tears through the chamber. Jacqueline collapses into her chair as the courtroom erupts in pandemonium.

"Mom? Are you all right?"

Jacqueline waves her son away. She bows her head and buries her face in her hands. Under her breath, over and over, she repeats the words, "I want my image back. I want my rights back," as the chattering of the assembled multitude echoes in her ears.

It seems to take forever for Jacqueline and her son to exit the courthouse, but

eventually they manage to escape. Jacqueline's car drives them to her house, a small place on the outskirts of Beverly Hills; during the ride, Jacqueline stares impassively out the window, ignoring the solicitous behavior of her overly-concerned son. Finally, the car drops them off at the gate and then drives off to the garage.

Jacqueline takes a few steps towards the house, but her son jumps in front of her. "Let me help you, Mom," he says, proffering his arm.

She turns aside. "I can walk to the house by myself, Milton."

"Are you sure, Mom? It's no trouble having you lean on me."

Jacqueline bristles at her son's words. "I don't need to lean on anyone," she says. She hobbles her way to the house as quickly as she can. Milton walks with her, matching her pace, although he is constantly leaning forward as if eager to get moving.

Sure enough, as the front door slides opens for Jacqueline, her son looks around and says, "Will you be all right, Mom? The studio's expecting me back soon."

Jacqueline nods. "Go, Milton. Attend to your business," she says, trying her best to keep the bitterness out of her voice.

Milton sighs. "Mom, don't start up with that attitude of yours again."

"Don't talk back to me like that."

"Mom, you know—" Milton begins, but Jacqueline silences him with a glare. He shakes his head, says, "Never mind," turns around, and walks out. The door slides closed behind him.

Jacqueline lets out a long sigh, passes through the entrance hallway, and walks to her living room. She pauses to take in the contrast between the clutter of her furnishings and the bareness of the walls, their whiteness marred by empty hooks and the sticky residue of tape. How long has it been since she removed all her—or rather, all her avatar's—movie and webcast posters? Not long enough.

She hobbles around tables, lamps, chairs, and the sofa, and collapses onto her comfy chair, which begins massaging her legs to encourage circulation. She leans back for a moment, then swivels the chair so as to face the entertainment center.

"News," she says, and the EC turns on.

The first news story that the EC broadcasts annoys Jacqueline, for it is about the final resolution of *LaRue v. Evercom*. She's not surprised, of course—her preferences are set to scan for her name—but she is still upset to hear the commentary on her lawsuit. The reporter talks about her lawsuit being a test case for the hundreds of elderly actors who found themselves in the same position, and then interviews an aged film historian by the name of Jenkins.

"Professor Jenkins," the reporter says, "I've heard that your sympathies lie with the studios. Is that correct?"

"Not entirely," Jenkins says. "Although I do agree that the actors brought it upon themselves."

"Even Jacqueline LaRue?" the reporter asks. "She says that the contracts she signed were standard at the time."

"It's not just a question of the contracts," Jenkins retorts. "Originally the studios wanted to use synthespians. It was SAG which forced the studios not to use purely computer-generated actors."

The reporter interjects. "And that led to the current situation, where 99 percent of actors are out of work."

Jenkins nods. "True. After all, now that actors can essentially license their avatars into perpetuity, it's created a major population explosion in Hollywood. Not only have actors lost control of their rights, as in LaRue's case, but with so many of them crowding each other out, their individual value has plummeted." Jenkins shakes his head. "The odds of success are the worst they have ever been. Why anyone would go into the profession today is beyond me."

Jacqueline decides she has heard enough. She too has sometimes won-

dered if her life would have been better had screen actors been thrown out of work by synthespians. But she has thought about this far too much recently.

She says, "Library," and the EC freezes the news broadcast. Jacqueline considers a moment, then settles on one of her first films, for old time's sake. "Play *Reach for the Moon*."

The strains of violins usher in an old-time view of the New York City skyline, panning past the World Trade Center memorial, and Jacqueline smiles. Unlike all of the films that came just ten years after, this one she actually acted in. And even worse, they filmed on location, on some of the hottest days of the New York summer. As the story begins, Jacqueline remembers back to those wretched days. The crew woke up at dawn in order to wolf down the "non-deductible" breakfast, a bland egg-and-cheese-on-croissant sandwich that the studios were required to provide without deducting the cost from the crew's salaries. Then they would rush to location, and sit around for hours until it came time to film their scenes, the classic example of "hurry-up-and-wait." Eventually, after spending a day capturing perhaps two or three minutes of footage, they would go home late at night, exhausted. And the next day, the whole thing started over again.

A tear wells up in Jacqueline's eye. She wipes her face and continues to watch the film.

The story unfolds. Jacqueline's character, a high-school teacher named Heather, meets a politician named Daniel, whose goal is to become the world's first private astronaut. A corny plot, perhaps, but a satisfactory love story nevertheless. And Daniel is played by John Packard, an actor Jacqueline remembers very fondly.

The film comes to their first kiss, and Jacqueline recalls the taste of John Packard's lips on hers. She had felt something more to the kiss than just acting, and sure enough, in a short time the

tabloids were having a field day with their relationship. John and she might have had something together, but he died tragically in a set accident on his last film just before she planned to propose. An old-time actor, forever frozen in the past.

But not completely. Jacqueline knows she could see John again, looking as lively and sexy as he once did, by turning on the sitcom *Out of Luck*, currently produced on the WBC network. John's avatar has kept that show in the top ten for almost twenty years now, despite the way it has bounced from network to network. He's as popular today as he was the day he died.

But at a price.

As the kissing scene fades away to a courtroom scene, Jacqueline shuts off the EC. She doesn't want to be reminded of the battle she lost today; she doesn't want to be reminded of anything. Slowly, she eases herself out of her comfy chair. With a firm grip on her cane, she creeps over to the stairway. She rides the stairlift up to her bedroom, removes her dress, falls into her plush king-sized bed, and cries herself softly to sleep.

At three in the morning, Jacqueline awakens from an acting dream that quickly fades. *Like clockwork*, Jacqueline thinks. *I always have to go to the bathroom at three in the morning*. Moaning, she pulls her creaky body out of the bed, feeling the stiffness as her muscles stretch and her joints crack.

The house arranges for the dim lighting to follow her as she walks to the bathroom. She sits on the toilet—a toilet whose seat has been raised solely for the purpose of cleaning during the past ten years—and does her business. She goes to the sink to wash her hands and catches a brief glimpse of herself in the mirror. She drops the soap.

Staring back at her is her avatar, an image of her frozen permanently at the age of twenty-two. Its hair is blond, its skin is smooth and unblemished, its eyes are

cold crystal blue. Jacqueline is wearing nothing but panties and a bra over her wrinkled form; the avatar is dressed in a sleek red gown that accentuates every smooth, delicious curve.

"You're not me," Jacqueline says aloud. Her voice sounds strange in the dead of night.

The avatar replies in her mind. *No, I'm not you. I'm just an image, a reflection, a pale and distant copy*. The image shakes itself around, jiggling its bosom, and it purses its lips coquettishly.

"Stop that!" Jacqueline yells.

The avatar freezes in place and then straightens up. *Why, what's the matter? Aren't you glad to hear me admit that I'm not real?*

Jacqueline shudders. "If you're not real, what are you doing here?"

The avatar laughs. *I have nothing to do with it, Jacqueline. I didn't choose to be here. You were the one who brought me to life*.

"No," Jacqueline whispers. "It wasn't me. It was Malone Studios that did it."

But you signed the papers—Mother.

Jacqueline recoils from the mirror, but can't bring herself to leave the bathroom. "Don't call me that. I am not your mother."

You're more a mother to me than you ever were to Milton.

"Leave Milton out of this!"

Fine. Milton has nothing to do with this. It's just you and me.

Jacqueline buries her face in her hands for a moment. When she looks up again, the avatar is still in the mirror. "What do you want from me?"

I don't want anything from you, Jacqueline. It's you who seems to want something from me.

"What? What do you think I want?"

The avatar lifts its eyebrows and opens its mouth in surprise. *My death, of course*.

Jacqueline feels herself starting to cry. "No. I don't want to kill you. I just want my own self back."

You can't have one without the other,

ANALOG

the avatar replies. *You've been trying to kill me throughout your whole lawsuit.*

"That's not true."

The avatar shrugs. *I suppose you're right. After all, you can't kill something that's not real.*

"Don't say that."

Why? Isn't that what you want to hear? That I'm not real? The avatar stares deeply into Jacqueline's eyes, and then suddenly snaps its fingers. *I think I understand now.*

"You don't understand anything."

Sure I do, Jacqueline. It's the fact that I'm not real that bothers you. Because my very existence reminds you of your own mortality. I'll live forever, while you waste away into nothingness.

Jacqueline screams, but it emerges as a weak yelp. "Why are you taunting me?"

The image in the mirror leers at her. *You're taunting yourself, Jacqueline LaRue. The avatar smiles. Look at me. I'll always be younger than you. Prettier than you. Sexier than you. And there's nothing you can do about it.*

Jacqueline punches the mirror, but her fist bounces off the shatterproof glass. The avatar laughs, loud and long, and Jacqueline runs as fast as she can from the bathroom.

Jacqueline wakes up early, as she does every morning, with the sunlight streaming through the large picture windows. She thinks back to last night. No matter how vague her confrontation with the avatar seems now, in the morning light, she knows it was not a dream. The thought that she is losing her mind nags her, playing around at the back of her head. Eventually, she sighs and climbs out of bed, resolved to discuss the issue with Stebbins.

Jacqueline showers, dresses, and heads downstairs to the kitchen, where a bowl of bran cereal in skim milk and a hard-boiled egg already await her.

Halfway through her meal, the house requests her attention. By Jacqueline's choice, it speaks in a strict mechanical

monotone. "Ms. LaRue."

She swallows a mouthful of cereal. "Yes?"

"Your son Milton and your lawyer Ray Stebbins are at the door."

Jacqueline sighs, and instructs the house to admit them. Within a moment, Milton and Stebbins join her in the kitchen. Milton takes a seat on a tall stool across the high counter from her, while Stebbins stands off to the side.

"Hello, Mom."

"Hello, Ms. LaRue."

"Hello, Milton. Hello, Ray," she says, and she swallows the rest of her egg. "What are the two of you doing here?"

Milton glances at the lawyer. "What are we doing here? How about asking how we are, first?"

She grits her teeth, then asks, "How are you?"

Milton shrugs. "Okay, I suppose. Sandra and I stayed up late, discussing the verdict."

"I don't want to talk about it," Jacqueline says. She continues eating her cereal.

Milton nods and looks down at the counter. "I understand."

"Can you really?" Jacqueline asks.

He looks up at her and sighs. "I don't know, Mom, you tell me. Can I understand?"

She thinks for a moment. "I'm not sure you can. I'm not sure anyone can, unless they've been there."

"But I can sympathize, Mom. You have to at least grant me that." He looks around the kitchen, at all the modern conveniences of home, and then looks back at Jacqueline.

"I suppose," she says.

Milton nods. "Mom, there's a reason we came here this morning, and I'm afraid it does have to do with the case. I have an idea."

"An idea?"

"Yes. Which I've already run by Ray." He pulls a data chip out of his pocket. "I've programmed something on this. I'd like to plug it into the EC and show it to you."

Jacqueline considers for a moment, then says, "Go ahead. I'll be in there in a moment."

Milton leaves the kitchen, and Stebbins takes the seat he vacated. Jacqueline nods at him and continues to eat her breakfast.

"So what is this idea, Ray?" she asks between mouthfuls. "And why didn't you think of it yourself?"

Stebbins looks around the kitchen, avoiding eye contact with Jacqueline. "I didn't think of it because I'm not the head of a studio, like your son is. And honestly, I don't think it will work."

"So what is this idea?" Jacqueline asks again.

Stebbins shakes his head. "I think Milton wants to show it to you, rather than have me tell you."

She grunts. "He doesn't like me, you know."

Stebbins remains silent.

"He doesn't," she repeats. "Never has. It's partly my fault, I guess. I forced him into his line of work, and he resents me for it."

Stebbins shifts in his seat, and his eyes look around the room. "Ms. LaRue, I really don't think—"

"Oh, hush, Ray. At this point, you probably already know all this."

"Some," he admits.

"Then you know that Milton keeps questioning my competency, ever since I started the lawsuit. Even when he hated me, he was willing to support me. Now," she says, "he just wants to put me away."

Stebbins shakes his head. "You misjudge your son, Ms. LaRue. The competency thing is just part of the legal strategy I suggested. Milton really does have your best interests at heart."

Jacqueline suddenly asks, "Do you have any children, Ray?"

Her lawyer looks flustered. "Um. No. Not yet."

Jacqueline nods. "When you do have children, make sure you respect them when they're young. Or else they won't

respect you when you're old. They'll think you're useless." *Especially*, she thinks, *when there's a younger, more useful version of you still around.*

She sighs and stares into space. "You know, first they suggest putting you in an assisted living facility. It'll be more comfortable, they say. After all, your bones are old, the chill remains longer in the air. And finally, you give in, thinking it will be for your own good.

"Then you find that you can't move as much as you could, even in the facility. So they suggest a nursing home. No, they tell you, with a twinkle in their eye, it's not just for people with Alzheimer's or other diseases. So, reluctantly, you give in.

"We're not honest about old age in our society. Or else the next step would be trying out coffins. Go ahead, they would say, it's peaceful, lying down all day, without a care in the world. . . .

"It's not that we're afraid to die. We're afraid of what might come beforehand."

Stebbins sits silently throughout her monologue, not responding. Jacqueline wonders if he recognizes it as a paraphrasing of a speech delivered by an elderly character in one of her earliest films. She never understood it, until recently.

Milton calls them from the living room. "I've got the chip installed," he says.

"Coming," she replies. She drinks down the last of her milk and gently eases herself off of her stool. She follows Stebbins into the living room.

Milton has already situated himself on the comfy chair, leaving Jacqueline and Stebbins to sit on the couch. "I've plugged in the chip," he says. "Watch carefully." He faces the EC. "Play."

Suddenly, Jacqueline's avatar appears on the screen. Before it can say anything, Jacqueline shouts, "Stop!"

"Mom?"

Jacqueline starts to hyperventilate, and Stebbins rushes to her side. "Ms. LaRue, are you all right?"

Jacqueline nods a few times as she gets her breathing back under control,

which requires a strong mental effort. "Milton, what the hell do you think you're doing?"

"Ms. LaRue, calm down," Stebbins says.

Milton lifts his hands, palms out. "Mom, it's not what you think."

She points at the screen, which displays her avatar frozen in place. "I think it's my avatar! I've banned it from this house!"

"I know, Mom," Milton says softly. "I was there."

She stands up slowly, propping herself up on her cane. "So how could you bring that atrocity into my home?"

"Because," Milton says, smiling, "it's not from Evercom. Just watch." He turns to the EC. "Play."

Keeping her fury in check, Jacqueline watches her avatar and listens to the words Milton has given it. As the realization of Milton's plan finally dawns, Jacqueline does something she has not done in a long time.

She smiles.

A few days later, Jacqueline finds herself back in the same courtroom, with the same arbiter at the front, and her lawyer at her right. Milton sits at the witness stand. Once again, the room is filled with spectators, a mix of aging actors and young fans. Only this time, Jacqueline is sitting on the defendant's side. Evercom's five lawyers sit at the plaintiff's table.

And Jacqueline is loving the whole thing.

On a screen in the front of the room, Jacqueline's avatar is moving around and talking. Jacqueline barely hears the words Milton generated for the avatar, as she is too focused on the arbiter's reactions.

Finally, the image fades away, and the arbiter looks back at Jacqueline and her lawyer. He clears his throat and says, "Mr. Stebbins, what sort of theatrics are these?"

Stebbins jumps up. "Your Honor, these are not theatrics at all."

"Where did you get ahold of the avatar?"

Milton and Stebbins exchange a glance, and then Stebbins says, "Objection, Your Honor," at the same time Milton says he is pleading the Fifth Amendment.

"Hm. Without questioning your witness, Mr. Stebbins, it seems to me that what Mr. LaRue has done is illegal."

One of the Evercom lawyers stands up. "Your Honor."

"Yes, Mr. Vogel."

"Evercom would like to go further and state unequivocally that what Mr. LaRue did is most definitely illegal. Creating his own film using Jacqueline LaRue's avatar is a violation of Jacqueline LaRue's contract."

Milton turns to the lawyer. "Reread the contract. It's true that my mom sold her avatar rights in perpetuity, but she didn't sell exclusive rights."

The Evercom lawyer steps forward, continuing to address his remarks to the arbiter. "That is incorrect, Your Honor. Her contract clearly states that she cannot license her avatar to any other studio."

"My mom isn't a studio," Milton says. He stands up and looks ready to step out of the witness stand.

The bailiff begins moving forward, but the arbiter raises his hand. "Mr. LaRue. Please remain seated and address your remarks to the court."

"Sorry, Your Honor." Milton sits down.

"And explain your last statement."

He smiles. "Your Honor, there is nothing in the contract that prevents my mother from making her own spots with her avatar. She can record her own messages and broadcast them on television, film, the Web—anywhere. And as long as Evercom insists on using her avatar in their productions, Mom will ask her fans to boycott any productions in which her avatar appears. No, strike that. Her *avatar* will ask her fans to boycott those productions."

For a moment, no one speaks. Then Vogel walks up to Milton. "What makes

you so sure her fans will listen to her?"

"What makes you so sure they won't?" Milton retorts.

Vogel looks up at the bench. "Your Honor, this is legal hairsplitting. After all, Mr. LaRue, who obviously created and programmed the avatar, does own a studio, even if his mother does not."

The arbiter studies his handheld for a moment and then shakes his head. "On the contrary, Mr. Vogel, the court agrees with Mr. LaRue's interpretation of the contract. Ms. LaRue would be perfectly within her rights to create her own spots, even if she contracts out the actual work to her son's studio."

The room fills with cheers from the spectators, and the arbiter bangs his gavel repeatedly for silence. Jacqueline merely smiles, thinking that she has finally won.

"It didn't work, did it?" Jacqueline asks her lawyer. Her voice sounds hollow in her ears.

From behind his desk, Stebbins hesitates, then grimly shakes his head. "Apparently not."

Jacqueline glances at Milton, who sits next to her in a large leather chair. "I don't understand," she says. "How can my own fans ignore my wishes?"

"Some of them do follow your wishes," Stebbins replies. "But the majority don't."

"We're using my own avatar to ask them to boycott my films. How could my fans be so . . ." Jacqueline trails off and stares helplessly at her son.

Milton shrugs, a frown briefly appearing on his face. "Haven't you been watching the nets?"

Jacqueline shakes her head. "I reprogrammed my EC. I've only seen the returns and ratings." She pauses, unsure if she wants her next question answered. "Why? What's going on?"

Milton sighs. "It's like this, Mom. Evercom's using your avatar for advertising as well. They've made a game of it."

"A game?"

"Yes. For every spot of ours in which your avatar urges a boycott, Evercom broadcasts five spots."

"Telling my fans to see the movie?"

"No. They've flooded the webs with their own images of your avatar making similar requests for a boycott, and asking fans to play 'Spot the Phony.' To win the grand prize, you have to go to your avatar's latest film, or else you can't enter." He clicks his tongue. "Apparently, your fans find it amusing."

"Amusing?" Jacqueline asks in disbelief.

Stebbins nods. "Amusing enough to play the game."

Jacqueline leans back in her chair and stares into space. "A game. They've turned my life into a game."

Milton briefly takes Jacqueline's hand. "I'm afraid they have." He pauses. "Mom, our avatar's not working, and it's costing LaRue Productions a lot of money every time we run it. I think—I think it's time to give up."

Jacqueline feels tears welling up in her eyes. "I can't give up."

Stebbins hands her a tissue, and she dabs at the moistness on her cheeks. Through her blurred vision, she thinks she sees Milton and Stebbins glance at each other.

"Ms. LaRue?" Stebbins begins.

"Yes?" she asks with a sniffle.

"Ms. LaRue, your son and I have discussed it, and there's still one more option. That last option. The one we talked about before."

Jacqueline looks back and forth between her lawyer and her son, and then shakes her head vigorously. "Absolutely not," she whispers.

"Mom, it's the only way," Milton says. "Getting the court to declare you incompetent—"

"Never," she says with as firm a tone as she can muster.

Stebbins clasps his hands together. "Ms. LaRue, consider it."

She shakes her head again. "Ray, I was never incompetent. Not when I signed the contract, and not now."

He nods. "No, you weren't. You were young when you signed the contract, though," Stebbins says. "You were impressionable. You didn't know what you were getting into, what you were giving up. Right?"

Jacqueline nods, but doesn't speak.

"But," Stebbins continues, "those arguments didn't hold up with the arbiter. This one can."

"This one not only can work," Milton adds, "but it will work. That is, if you let it."

Jacqueline sighs. "Ray, Milton, you don't understand. I'd be admitting that I was incompetent to run my own affairs for my entire life. Even if we could convince the arbiter—"

"—which we can—" Stebbins interjects.

"—I still can never see myself agreeing to it."

Once again, Jacqueline's son and lawyer glance at each other. Without a word, Milton stands up and pops a chip into the player Stebbins keeps in his office. It turns on automatically, and the image on the screen fills Jacqueline with horrified fascination.

It is her avatar, wiggling with delight in a tight blue dress and smiling at the viewer with dimpled cheeks that never existed. In a squeaky, Mickey Mouse voice, the avatar says, "Don't go see my new film! Stay away! Stay away!" Then, as it keeps smiling and wiggling, a voice-over exhorts the viewer to come see *The Sweetheart Next Door*, Jacqueline LaRue's latest masterpiece.

Milton stabs at the control and the screen goes blank. He turns to Jacqueline, a blank look on his face. She turns away from his stare and faces Stebbins.

"Well?" Stebbins asks.

"I'll do it," she replies.

Jacqueline collapses into her comfy chair, exhausted. She has spent the day doing interview after interview, publicizing the final decision of *Evercom v. LaRue*, doing her best to appear incom-

petent on camera. Milton and Stebbins have seen to her comfort during this time, and have brought her home. Milton dashes to the bathroom, while Stebbins sits on the sofa.

"I am so glad the ordeal is over," Jacqueline says after a moment of catching her breath.

"You deserve to rest now, Ms. LaRue," Stebbins says. He chuckles nervously. "I'll send my final bill to your son tomorrow."

"My son?" She smiles. "This was my case. Why not send me the bill? You know I'm good for it."

Just as Stebbins is about to reply, Milton emerges from the bathroom and says, "Congratulations again, Mom." He glances at Stebbins, who stands up, and then he looks back at Jacqueline. "I'll see you again soon."

Jacqueline raises an outstretched hand to her son. "Milton, wait."

"What is it?"

She thinks for a moment as to the best way to put this. Finally she settles on something short and sweet. "Milton, I've mistreated you, and I'm sorry. You helped me out in my time of need, and I'm grateful. Thank you. For everything."

He pulls his lips in for a moment, then says, "You're welcome, Mom."

"Milton? Is something wrong?"

"No, nothing's wrong," he says a little too quickly.

Jacqueline feels a sudden chill; she recognizes Milton's tone far too well. "Milton? What are you hiding from me?"

Milton sighs. "If you insist . . ." He turns to Stebbins. "Ray, show her."

"Show me what?"

Ray's forehead is damp with perspiration, and he fiddles with the knot of his tie. "I can't do this, Mr. LaRue."

"Then I will." He pulls out his handheld and shows it to Jacqueline. "Read this."

Jacqueline takes the handheld in puzzlement. She reads the document on the screen, granting LaRue Productions, and not Jacqueline herself, the license to her avatar in the event Evercom releases the

rights back to her.

"What the hell is this?" she asks.

Milton snatches the handheld back from her. "You've been declared incompetent, Mother. Remember? As your next of kin, I'm now in charge of your estate. And as I used my production company's resources to pry loose your avatar, I've decided that it's mine now."

Jacqueline takes a deep breath. "I never agreed to that. Tell him, Ray. He doesn't control my avatar. I do now."

Jacqueline's lawyer looks off to the side, clears his throat, and leaves the room.

"Ray!" she shouts, but he is already out the front door. She turns back to Milton, who is smiling.

"You should have been more careful, Mom," he says softly.

Jacqueline leans forward to slap her son's face, but he easily pulls back.

"Why?" she asks. "Why are you doing this to me?"

"Because it was always about you, Mom. You, you, you. The only reason I ended up being a producer was because you wanted your son to be in the business. To get your avatar gigs, to give you some semblance of control."

Jacqueline wants to protest, to tell Milton that it wasn't that way at all. But she knows she can't.

"Milton, you can't do this to me. I'm your mother."

Slowly, he shakes his head. "Maybe in a biological sense. But that's all."

Jacqueline tightens her mouth and glares at her son, hoping to show him some small measure of defiance.

He chuckles. "Does it occur to you how valuable your avatar is? Especially now that your fans will know that its appearances have the complete approval of the LaRue family. And it's not like I'm cutting you out, Mom. You'll be getting much higher royalties now than Malone or Evercom ever granted." He sweeps his arm around. "You'll be able to afford so much more than this."

"That wasn't the point," Jacqueline

says.

"True. The point was that you always ignored your family before, except with respect to what we could do for you. Well, now I'm returning the favor. I got the avatar rights back for LaRue Productions, Mom. Not for you."

"Milton, I never meant to—I never wanted to—*please*."

Milton looks down at the floor, and for a moment Jacqueline hopes he has changed his mind. But all he says is, "Mom, we'll talk. I'm not going to use your avatar for anything gauche. But—I *am* going to use it."

As he turns to leave, Jacqueline tries one last plea. "The media, Milton. They're going to assume that I was conspiring with your studio to make a profit. They'll claim that my whole desire to get my image back was simply an act."

Milton sneers. "So what? They'll consider it the greatest performance of your career."

Milton darts out of the room, and as the front door slides behind him, Jacqueline feels tears begin in her eyes. She wipes them away, sniffing. Directly in front of her sits the EC. "Play," she instructs it, hoping to lose herself in someone else's Hollywood fantasy.

But when the EC screen comes on, Jacqueline's avatar—*young, beautiful, and fake*—appears. It begins pleading with her fans not to support her films, and Jacqueline realizes that Milton must have put his programmed chip inside the device, as a final taunt.

Jacqueline hobbles over to the EC. She lifts her cane and jabs it suddenly into the screen, smashing it into sizzling glass pieces. Screaming incoherently, she hits the screen again, and again, and again, and the shards of glass fall to the carpet. She collapses onto the floor, covering her ears with her hands and keeping her eyes tightly shut, begging for solace from the mistakes of her youth.

But the voice of her avatar will not be silenced, and its image will never fade away. ■



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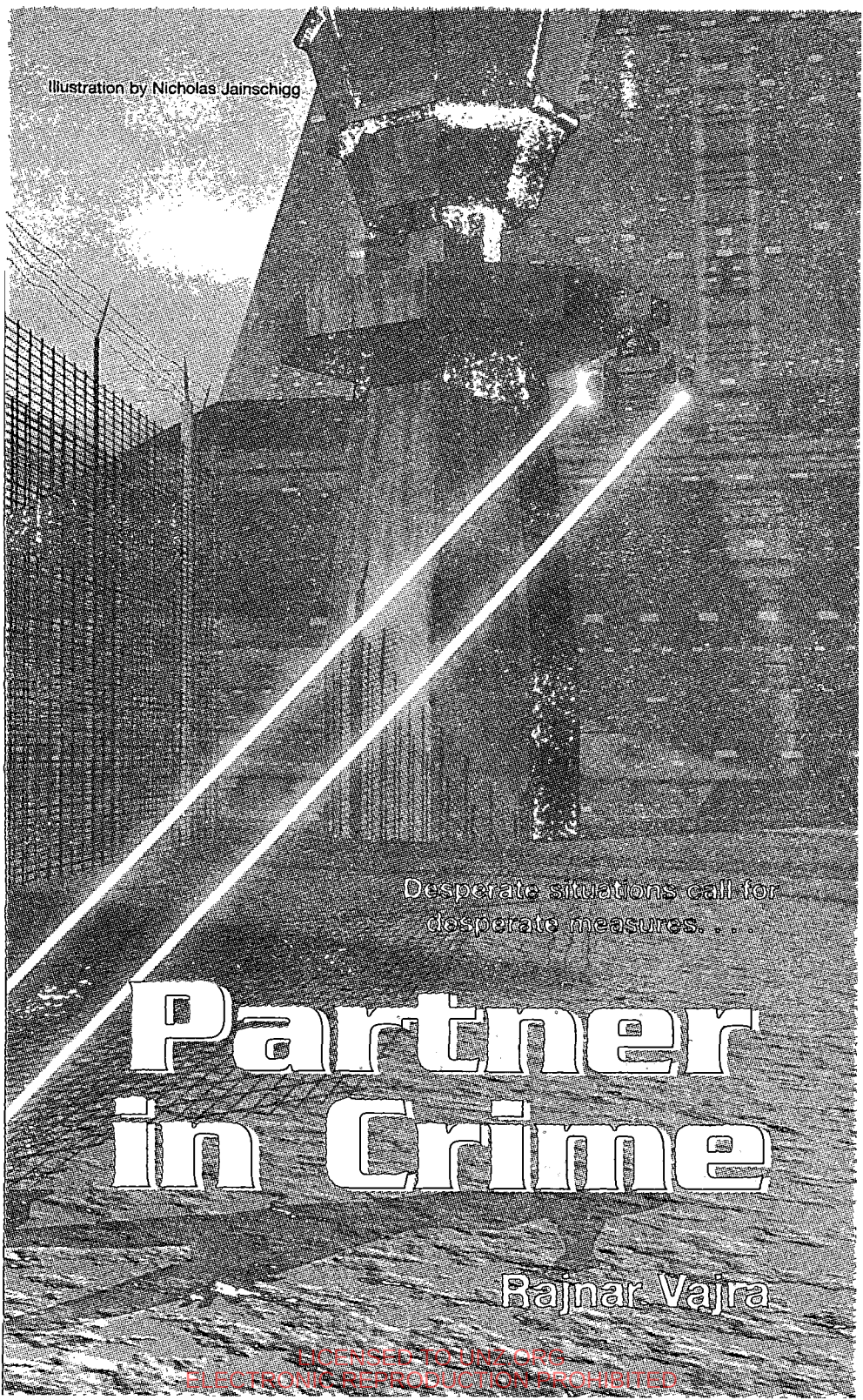


Illustration by Nicholas Jainschigg

Desperate situations call for
desperate measures. . .

Partner in Crime

Rajnar Vajra

LICENSED TO RECORD
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I hadn't planned to break out of prison that day—or any other day, month, or decade. The crazy lady changed my mind.

Four men, if you include me, were crowded into the operations room, gawking at a wall-sized digital membrane set to show the outdoor exercise yard. The image was clear enough for counting dust motes, but what it revealed seemed staged, unreal, an action-adventure Experience soon to be interrupted by another interminable batch of commercials. There, on the molecule-thin screen, a female prisoner was sprinting toward the chain-link perimeter fence, which was thirty feet tall and crowned with eighteen strands of barbed wire angled progressively inwards. Like any good action-adventure heroine, the woman was incredibly, impossibly quick.

Outside, yard guards and assorted prisoners were enjoying this free show, standing well beyond the line of fire and placing hasty bets, probably on how close to the fence the runaway would get before being mowed down. Female inmates were rare in Canicula Ultra-Security Penitentiary (which says flattering things about estrogen). This particular inmate looked fit enough, but delicate and terribly vulnerable . . .

Canicula is the prison of last resort, normally only used as a reservoir for multiple murderers who are lucky enough to be captured someplace where capital punishment is banned. The world Nintu, where Canicula squats like a giant concrete toad, has no such prohibition. Any escape attempt from this jail brings automatic execution, yet barring a miracle, the crazy lady had absolutely no chance of success. That's how I knew she was crazy.

The guard to my left, Larry Addio, was seated at the main console. He was muttering to himself, taking his time about aiming the roof lasers. To my immediate right, my personal guard, Phil

with the big head, chewed wintergreen gum with his mouth open and divided his time between watching the screen and minding my business. This was the first time I'd ever seen him disobey his orders, which were to *never* take his eyes off of me when I was out of my private cell. Even with a minty obstacle, his breath smelled of raw onion. He chewed onions by the bushel. Maybe he was addicted.

Past Phil loomed a transplanted Texan from Earth, Chief Warden Mike Mogis—less a bear of a man than a man of a bear. He was so outrageously big and hairy that everyone suspected there'd been some illegal gene-grafting somewhere along his personal branch of his family tree. The warden's tiny brown eyes glistened with erotic interest as he watched the virtual crosshairs orient on the intended victim. Mogis liked women in one limited sense: He liked to hurt them or see them hurt.

Looking into the operations room, you could tell at a glance that one of us wasn't a guard. Not only was I dressed in convict anti-camouflage denims, which would change color and texture to stand out from any background, I was unarmed . . . unless you regard a soft plastic bucket half filled with sudsy cleaning solvent as a weapon.

I'd only recently become a prison trustee. Even after an experimental "treatment" designed to curtail certain antisocial activities, it had taken me two years of behaving like an unusually docile sheep to attain the honor of being allowed to scrub this particular room. Any other murderer would have qualified in half the time, but none could match my sordid history.

Yes indeed, even among the galaxy's foulest collection of killers, sexual predators, and terrorists, I stood tall. So, despite the fact that every control mechanism here was coded to the DNA of authorized operators and also required frequent confirmation signals from the operators' Partners, Mogis didn't trust

me to work unsupervised in such a vital part of Canicula Penitentiary. They were fairly convinced they'd taken away my hobby, but I still had my reputation.

Also, one hell of a miserable secret.

Halfway across the yard now, the nut case should've been dodging and weaving for all she was worth, not that it would've done her any good. Instead, she kept running in a straight line. Even crazier, it was a diagonal line with respect to the fence, ignoring the most direct route. Unless she altered course, she was going to wind up near the East Tower, which was equipped with its own battery of remote-controlled weapons. Maybe she was simply trying to kill herself in a roundabout way. I suppose it was a nice enough day for suicide; cloudless and crisp. Larry tapped a stud, two smoking holes appeared in the woman's right thigh, and I figured that was that.

I figured wrong. She jerked from the sudden pain, but instead of collapsing, she took four hops on her good leg and then flipped herself over, caught her balance in a handstand, and resumed running along the same route . . . on her arms! And I mean *running*—pushing off into the air on her fingertips, her nearly vertical body tracing a low parabolic arc, landing smoothly on the heel of the next reaching hand, pushing off again . . .

I'd never seen anything like it and neither had my keepers, judging by the dropped jaws and bulging eyes. It occurred to me that if I hadn't followed my programmed instinct for service and made the effort to become a trustee, I would've missed this. That same compulsion made me damn glad I was there! I suddenly realized that I wasn't going to remain a passive witness much longer.

I *had* to act. Not only had my protective instincts arisen upon seeing the woman injured, but something deep inside me insisted that her startling level of courage and skill should, in a decent

universe, result in more than her defeat and eventual death. A plan quickly coalesced. But was my timing up to the task? Was my oversized, underexercised body sufficiently quick and agile?

Fighting my mental conditioning and doubts, I dropped my bucket, reached out toward Larry's holster, snatched his shock-pistol free, spun around, and pointed the weapon at my personal watchdog, Phil.

An intelligent person would've assumed that the pistol couldn't fire with me holding it, but no one would mistake Phil for an intelligent person. Only gum or onion kept him from being utterly slack-jawed. Staring down the barrel of a class IV pain-inducer did nothing to sharpen his wits.

He did exactly what I'd counted on. He panicked, drew his own weapon and fired at me. I'd been watching his trigger finger and threw myself to the side just as that finger tightened. The harmless guide-light and far less harmless beam caught Larry in the chest just as the disarmed guard was rising from his chair.

As poor Larry squealed, convulsed, and collapsed, I kicked the pistol from Phil's hand hard enough to nearly break my toes. Then, without looking, I reached back to get a grip on Larry's arm. I tugged his hand in front of my body and dropped to my knees to avoid supporting any extra weight. Guilt feelings were making my legs weak and rubbery. It could've been worse. Luckily, I was very much accustomed to guilt.

By now, Mogis was trying to push Phil aside to get a clear shot at me. But Phil, whose face displayed an unprecedented level of determination, seemed entirely focused on backing away. Although he was far smaller than the warden, he was tangling Mogis up brilliantly. If I hadn't been so busy and scared, I might've applauded! Spilled cleaning solution made the floor nice and slippery, which deserved a second ovation.

In the confusion, I put the gun into Larry's limp hand, placed his finger on the

trigger, wedged it in place with my own fingers, and had the weapon aimed by the time Mogis finally extricated himself.

Unfortunately, the warden was infinitely brighter than Phil.

"Real cute, Karl." He sounded smug and surprisingly calm, but the fire behind his piggy eyes gave him away. "You've set things up purty good—so you think. If'n you want, you can squeeze that trigger usin' his finger. But it just won't wash, boy."

"It won't?" I tried to look discouraged and confused.

"Course not! You must have some half-assed notion of hijackin' his DNA for shootin' purposes. But I'll tell you right now that it takes more'n a good finger for that weapon to work. It takes Partner permission, boy, and that you can't get. Hellfire, it's our *Partners* what do the DNA confirmation, not the guns, and his already knows that its boss is out cold. Different brainwaves, right? So just you let go of Sergeant Addio there and stand up real gradual and we'll get this whole mess sorted out."

I glanced down at Larry's arm. On his exposed wrist, a gray, translucent film was thickening. Tiny tendrils emerged from the film and reached out to touch Larry's hand, my own hand, and the gun. Some types, I suppose, need extra reassurance.

"See that?" Mogis continued triumphantly. "There's Addio's Partner now, checkin' on what's what." He chuckled. "It surely won't be helpin' you any."

It was a shame to disappoint him, but I had no choice. I quickly shot the warden and then sent Phil to join him on the floor.

Then I got a shock of my own when Mogis slowly rose up, shook his head, and began lurching towards me; I would've sworn a class IV jolt could stun an elephant! He'd involuntarily flung his weapon across the room from pain-inducer spasms, but the man was plenty dangerous even without a gun. Incredi-

bly, it took two more shots before he stayed down.

Sweating fiercely, I let the weapon drop out of Larry's hand, but kept hold of his arm.

Guilt can be an incredible burden. I should know. It took all my willpower to hoist Larry, drag him back to the console, and place his hand on the laser controls. In a sense, using Larry was unnecessary: My dirty secret allowed me to bypass all authorization requirements. But when the lasers had been activated, a recording device on an independent circuit had automatically turned itself on and I had no fast way to turn it off. Everything happening in this room was being recorded, so the more obfuscation I could generate the better, if I hoped to *keep* my secret. That's why I'd used Larry's finger for shooting rather than my own.

Using Larry's hand, or pretending to use it, I turned the two roof lasers toward the even heavier weapons mounted atop the East Tower: a tall blockhouse at the eastern end of the fence. Four seconds of coherent light transformed thousands of dollars of steel, glass, plastic, synthetic sapphire, and wiring into rainbow-stippled puddles.

The lady was now more than halfway up the fence, pulling herself upwards hand-over-hand. I couldn't imagine how she hoped to get over the barbed wire, but it was easy to smooth her path. With the lasers, I severed the strands in the section she was approaching. Flash, slash. Then I aimed the lasers at each other and triggered them together. An instant too late, I realized that I could've just as easily cut a lower section out of the fence itself. . . .

The brightest yard guards were finally catching on that something was grossly amiss. Three of them drew shock-pistols and began running toward the escapee. I checked wind direction and used my sleight of hand routine again to spray sleeping gas where it would do the most good. My aim was sufficient. The yard

was suddenly a most tranquil place while the woman wasn't affected whatsoever.

I hurriedly made sure that the warden, Larry, and Phil were all still breathing; with pain-inducers, you never know. A stray impulse made me delay just long enough to entrust the bucket's handle into Mogis's care. The day I'd finally been certified as a trustee, he'd instructed me on the proper way to clean under the consoles: on my hands and knees. He hadn't offered to personally demonstrate the technique.

My final act in the room was to fake using Larry's hand to open the four-foot-thick emergency door to the exercise yard. Laser-bright sunlight, the noon-time dazzle of distant Sirius A, flooded the room and I gladly stepped outside.

People usually look better to me when they're asleep. A touch of childhood innocence seems to accompany the slack faces and snores. I tiptoed over sprawled bodies and dashed toward the fence. Cutting the barbed wire had almost certainly triggered silent alarms throughout the prison complex and there had to be guards already scrambling toward the operations room.

Turned out that the crazy lady made climbing chain-link look a lot easier than it was. Not only was thirty feet a surprising distance when placed vertically, but the zinc plating over the steel links was anything but smooth in places. My hands were soon bleeding freely, which made them annoyingly slippery. And I was having trouble getting full assistance from my feet; a few unlucky toes were still whining about their overeager contact with Phil's pistol. I was quickly accumulating a nice backlog of minor injuries.

On the far side of the fence, I simply dropped the last ten feet or so. Now it was my right knee's turn to protest while I caught my breath. Point finally taken: I needed to treat my limitations with more respect! Live and learn.

Somehow, the woman had negotiated twenty yards of steep cleared embank-

ment and had already reached the first trees of the exotic forest surrounding the prison complex. It looked like a pleasant spot for a picnic. The fringe trees were mostly everblues from Kent (Alpha Centauri's most inhabitable planet), plus a sprinkling of koa and mahogany, imported from Earth as seeds, genetically altered to thrive in the black soil of Nintu, under the twin but unequal lights of Sirius A and B. The forest smelled incredibly fresh and wholesome after the stale prison air. I skidded down the hill without quite losing my balance.

The woman had stopped and was sitting on the ground in a shady patch, staring back at me, wearing a faintly ironic, almost amused facial expression. Her inmate denims were glowing a fluorescent pink; her clunky prison shoes, in deeper shadow, were brighter yellow than a banana. She looked small and fragile, but I'd seen her scramble up that fence like a monkey, using only her arms. Her face was ordinary, unmemorable except for her eyes, which were large, intent, a peculiarly rich blue, and set at a feline angle under tawny eyebrows. Her skin was baby smooth with a golden tan about twenty shades lighter than mine, and her prison-cropped hair was brown with coppery highlights. I saw no blood on her hands; they didn't even seem scratched.

When I reached the trees myself, her first remark took me by surprise.

"I had no idea we'd planted someone to help me escape." Her voice was soft and low-pitched, but very clear. She certainly didn't *look* crazy.

"What do you mean?"

She blinked. "Wasn't it you who cut the wires?"

"Well, yes, and I triggered the sleeping gas. But no one 'planted' me anywhere. Far as I know."

She sat up straighter, a worried frown replacing her faint smile. "You're not—are you saying you're just a *prisoner*? How is that possible? How could you get control of the lasers and the gas?"

"I'm . . . handy with machines. And speaking of hands, I saw you running on yours. Impressive! Are you some kind of gymnast?"

She studied me for a moment. "Used to be a circus acrobat when I was young."

Young? She looked barely out of her teens. But appearances, as I knew so well, can be deceptive.

"Were you with the Cirque du Sirius, by any chance?"

"That's the one," she said without hesitation.

We'd certainly begun our relationship with a fine flurry of lies. On a hunch, I'd invented the name "Cirque du Sirius" by twisting the name of a world-famous institution, Le Cirque du Sothis. Apparently, she hadn't been on Nintu for long enough to know even the longer ropes. Interesting, that she spoke Nintu's crazy mix of English, Pinyan, Spanish, and Tamil like a native. . . .

She settled back, shaking her head ruefully. "I don't know how you got us out of there, friend, but I'm afraid you've wasted your time . . . and your life."

"How so?"

"Isn't it obvious? Any moment now, they'll be sending Furies after us. Those monsters can outrun and outclimb any human," she frowned, "even one with healthy legs. We might as well just sit here and make ourselves comfortable until the end. I'm Helene."

"I'm Karl," I said, then instantly regretted having supplied my real first name. I tried to smile reassuringly. "Actually, I'm counting on those Furies."

"Counting on them?"

"You bet. We need some kind of transportation, don't we?"

She looked at me as if I were the crazy one.

I suppose you could describe Furies as semimechanical hounds controlled by Partners so primitive they're more like antique *peecees*, the computers that Partners "evolved" from. But that paints

a grotesquely inaccurate picture. Furies are shaped somewhat like dogs, no argument there. Yet, few dogs grow nearly so large and none grow so tough. And what hound has such a long jaw? What hound has stainless steel teeth smoothly coated with borazon? What hound can run a mile in fifty seconds and keep up that pace for hours? Plus, canines have that age-old reputation as "Man's Best Friend." Furies aren't so friendly.

Whoever dispatched them was in too much of a hurry to bother opening the main gate. Instead, six four-footed monsters scrambled straight up the giant fence with impossible ease, going over the top in the spot where I'd removed the barbed wire. They leapt to the ground and waited on the hilltop, sniffing the breeze and staring down at us avidly.

"Do you suppose," I asked idly, "they're programmed to capture us or tear us to pieces?"

The woman shrugged. "Whichever way the wishbone breaks is bad luck for the chicken." She'd spoken like someone reciting an everyday saying, but it wasn't a saying from these parts. Chickens aren't common on Nintu, the only habitable planet in the vast Sirius system. But the planet is sheer murder on its genetically enlarged pigeons.

Suddenly the Furies snarled and leaned forward simultaneously as if they were networked, which they surely were. They were on us in three huge bounds. Six mouths opened wider than seemed physically possible. Metallic fangs gleamed wetly. Feral eyes protected by a ring of bony armor burned from deep sockets. But then six jaws closed on nothing but air. The Fury closest to me lowered its head, stuck out a wet, plastic tongue, and touched it gently to the back of my left hand.

"Our rides are here, Helene."

Her eyes were wide and wild. "This—this *can't* be happening."

"Pick any Fury and climb on board. Care for some help?"

A train terminal was only ten miles away. This was a good thing. After the first mile of bareback monster riding, I felt like I was straddling a log-splitter and I was the log. Not that I could complain. Helene seemed unaware of it, but this area was a terrible place for a casual stroll. Toliman Forest is an alien wildlife refuge, and therefore part of the prison security system. I wasn't eager to run into an adult stabtiger or one of the multiarmed, twelve-foot-tall dread-lizards that had made the first colonists to the Alpha Centauri system wish they'd chosen a more distant planet to settle.

I was draped over the largest Fury, leaning forward with my arms around its thick neck, my long legs pulled up so they wouldn't drag on the ground. The beast was running as smoothly as it could, but that wasn't nearly smooth enough for comfort. I looked over at Helene, who looked back at me and shook her head in bafflement. She shouted something, but I couldn't understand her over the rushing wind.

The terminal was a small platform near two north-south mag-lev monorails. It wasn't Grand Central. There was one bench, a button to push if you wanted a train to stop, and a ticket dispenser. It was deserted. I dismounted, awkwardly, and helped Helene to the bench. I made a shooing motion and our two Furies ran back in the direction of the prison. Mike Mogis was going to be one confused and unhappy warden.

"What were you trying to tell me," I asked, "two minutes ago?"

Her eyes were fixed on the departing killing machines. "Just pointing out that even if you can get us on a train, we're going to be awfully conspicuous."

"Don't you worry. I can do something about that."

I used my trousers to wipe dried blood off my hand, then placed that hand on one of her sleeves, currently striped bright purple and blazing blue. Four seconds later, she appeared to be wearing the kind of gray sporty outfit

suitable for a typical female tourist. I'd also converted her clunky, one-size-fits-all prison shoes into tall graceful boots. She looked down at her new attire, then gazed at me with narrowed eyes.

"I don't suppose you feel like explaining how you did that?"

"Perhaps later. Right now, I'd better grab us some tickets. I've always wanted to see Sothis City and this is my big chance!" In my ears, my cheery tone had a cheap, brittle edge.

The dispenser was mechanical, but its account-recognition circuit was Partner controlled. Therefore, no problem. With two freshly printed tickets in hand, I pushed the button and read the next train's estimated arrival time. We only had about five minutes to kill, and I guessed it would take the official search party several hours to reach this place. Our luck was still running, assuming the train was.

"How's your leg?" I asked.

"Numb and cold. That's a big improvement." She was staring at the tickets. "You don't happen to have money hidden away on you somewhere, or a credit card? Or maybe someone smuggled you a working Partner?"

"None of the above," I stated with deceptive truthfulness. "Like I said, I'm good with machines. We'd better get your wounds treated as soon as possible."

She pursed her lips thoughtfully. "That's easy to say. Look, I can't imagine how you've gotten us this far, and I want you to know I'm truly grateful. But no matter how many astounding tricks you have up your sleeves, we can't just . . . waltz into some hospital and expect help. By now, word about us must have reached three continents. And a few thousand islands."

"Agreed. But it might be possible for me to borrow a medical Partner for a few hours."

"Borrow a—I'd laugh in your face if I hadn't just test-driven a Fury! All right. Use your magic, whatever the hell it is. Get me a med-Partner and you've got a

friend for life. Good God. Are you *blushing*?"

"I've . . . never had a friend before. It sounds nice."

"Who are you? *What* are you? Exactly why are you helping me?"

"Just think of me as Karl, who'd like to be your friend."

Luckily, I was saved from further questions because the train whooshed in, three minutes and six seconds ahead of schedule. I barely had time to convert my own clothes into something less . . . formal, and wipe my other hand clean enough for public viewing. Naturally, I had to make my new clothes the rusty color of newly dried blood. A portal hissed open and I carried Helene inside like a groom carrying his new bride over the domestic threshold, an old European custom probably extinct on Earth.

We got some funny looks from other passengers, but not many. Our touristy garb rendered us semi-invisible. Plus, most of our fellow travelers were happily plugged into the train's entertainment system, where in-transit digital Experiences (mostly full-sensory cinematic extravaganzas) were relayed to their nervous systems via Partner mediation.

Even those few hardy souls who retained interest in their actual surroundings during the tedious transition between points A and B didn't stare at us for long. I guess we weren't all that interesting.

Convicted criminals are supposed to lose the privilege of having Partners. So, unless they are unusually talented, convicts can't do instant mathematical calculations, don't know the precise time without an old-fashioned clock, and can't play internal "video" games or replay cinematic Experiences to while away the boring hours and years.

Out of pure curiosity, I briefly plugged myself into the Experience. I was abruptly back about a century, standing in the Palace of Dragons' immense and utterly magnificent throne room, face to face with the Jingua Em-

press herself. Naturally, in this Hollywood version of history, she was unspeakably beautiful and irresistibly sexy. Her hand in mine felt warm and inviting, her smile seemed to tug at my soul—or at least my virtual gonads. And me? Why, I was none other than that celebrated galactic diplomat, Sir Henry Chang, larger than life and smoother than satin. The eccentric real-life hero who single-handedly (if you believe the six Hollywood extravaganzas thus far) nurtured a fragile peace during the Lukewarm War, in the bad years when the Jingua's Jade Throne and Dharmayuga's Diamond Lotus were perpetually butting heads over stellar boundaries.

I focused my attention on the exit icon and left the program. Personally, I much preferred looking out the window.

The final five miles only took thirty-four seconds, because there are low-pressure tunnels close to Nintu's main urban centers and the train could finally get up some magnetic steam. On Earth, as I recall, mag-trains reach almost Mach 4 in long, straight tunnels depressurized to reasonably hard vacuum. Here in the galactic boondocks, colony worlds are lucky if they even have trains. But then, few colony worlds have been terraformed and settled as long as Nintu.

As we left the train, I heard several passengers raving about the in-transit Experience.

"Seemed like the usual drivell," someone said excitedly, "until that part in the throne room. From then on, I was *there!*"

Sothis City seemed like a nice place to get lost in. The buildings surprised me by looking so tall; it's one thing to know, intellectually, that a given building has forty stories, quite another to see it towering. Helene and I figured out a way for me to carry her inconspicuously. We stood side-by-side. I had my right arm around her waist; she had her left arm gripping my left shoulder. With almost no weight on her right leg, she

could do a fair imitation of walking. Whenever possible, we used SCRT (Sothis County Rapid Transit) gyrobuses to reach a certain hotel I knew of.

People from more sophisticated parts of the galaxy often describe Nintu as having "Victorian" mores. The social climate here includes high-pressure fronts discouraging sexual indiscretions with a particular cloud on marital infidelity. Human nature being what it is, there is endless scurrying behind the scenes; I understand that Victorian England was much the same way. So, it isn't surprising that in seedier areas of Sothis, fully automated hotels cater to those seeking romantic trysts of the clandestine variety.

Eigeron's Hospitality was the city's largest automated hotel, and therefore the best place for us to hide. Check-in was accomplished at a simpleton digital membrane, even stupider than the dim-witted Partner at the train terminal. In fact, it was just barely intelligent enough to recognize my sterling qualities and obey my simple instructions. A room on the top floor suddenly vanished from the vacancy list without any indication of occupancy. All room services were activated with the increased energy usage divided, in all records, democratically throughout the building. Our fingerprint-scans were stored exclusively and temporarily in our room lock. The hotel now had two unregistered guests, the only couple who wouldn't be paying by the half-hour. . . .

A floating light led us to the elevator, up three floors, and along a stuffy corridor to our destination, number 314. The light vanished politely without waiting for a tip as I flipped on the overhead illumination. Our new hideaway smelled like that disinfectant I'd used in the prison bathrooms. Its mass-produced wall decorations were immaculately nondescript. I placed Helene gently on one of two robot-neatened beds, flopped down into a chair that had been sat in by too many people with dirty

forearms, and frowned at the room's only "window": a digital membrane displaying a tropical-beach scene.

The lack of windows was typical. Sirius A isn't one of those real vivid stars like Rigel or Vega, but it spits out enough UV to bleach curtains, carpets, and furniture faster than you can say "preventable expense." Private homes here usually have real glazing with costly UV filters, but then, private homes seldom have two hundred or more rooms.

The image on the digital membrane, our hideaway's only hint of romance, was sadly unconvincing. The white sand looked too, well, grainy. And the waves were rolling out to sea. The floating foam kept forming words: "Sexperiences available for a small additional fee." Half the letters were twisted into near illegibility. Clearly, the membrane was in dire need of rebooting and demagnetizing. Not good. . . .

"What's the matter?" Helene demanded. Maybe my frown had tipped her off.

"There are sixty-eight other worlds in the Commonweal where we'd be better off right now." Naturally, I hadn't included the seven "proscribed" planets or those unfortunate three worlds under the wide thumb of the Dominator. "I was hoping to get us booked on a starhopper and—"

"You're taking us off-planet? That, my dear, is a *terrific* idea!" I'd never seen her smile before. It transformed her face the way the rising suns transform the night. . . .

"We can't hide on Nintu for long," I pointed out, feeling strange, wondering why my heart was suddenly beating so fast. "I planned on, um, requisitioning our tickets right from this chair—and ordering us up some food from the automated room service. Just about now, every cop in Sothis must be holding our holograms, turning them this way and that to memorize our faces. Hiding up right here until our boarding time seemed smart."

"I agree. So what's the problem?"

"If we don't want them to find us, we need to keep all our transactions hidden and that takes some finesse. Look at that sorry excuse for a virtual window! The perfect ocean for—what would you call it? Retro-surfing?"

"I see what you mean. How about, ah, gnifrus?"

"Perfect. My point is that a garbled image implies corrupted software, Helene. How can I rely on a sloppy interface to relay complex instructions? Therefore, I'm going to have to venture out from our little haven to use a public interface. I'm not thrilled about it."

"I see. Then, may I offer a suggestion? I happen to know a little something about creating effective disguises. . . ."

"Do you?" Very interesting. "Tell me more."

"Dressing us as tourists for the train-ride was an excellent move, Karl. But we can do even better. We *have* to do better if we expect to sneak aboard a starhopper unmolested. The secret is to identify your most salient features and either hide them, exaggerate them, or create features that are *more* distinctive."

"Okay. What are my most salient features?"

"You're sizable, for starters. Not quite an ogre like that brute of a warden back at the jail, but you definitely stand out from the crowd. And your face is a real problem. That much character makes it memorable. Also, you have that whop-ping big nose. Why are you smiling?"

"I'm enjoying your tact. What do you expect me to do? Walk on my knees and go to a nose-shrinker?"

Her laugh had a pleasant musicality, a sweet viola with bell overtones. "Actually, there *are* ways to make your nose seem smaller. For example, we could fatten your cheeks—we might even consider that, if this room has one of those plastic Gideon bibles, but I've something else in mind. As to your height, the classic approaches are to either put you in a wheelchair or make you even

taller."

"Wouldn't those things make me more conspicuous?"

She nodded seriously. "In a sense. You'll get noticed faster but you'll also get dismissed faster."

"I'll take your word for it. Let me think. A wheelchair might slow me down too much; I've never used one. But I'm willing to try for giant status. Any suggestions for instant growth?"

"Perhaps. That trick you did with my shoes. I had no idea prison shoes were so adaptable."

"They're not supposed to be."

"Can you build up the internal padding so that your shoes look fairly normal from the outside, but give you three or four inches of platform to stand on?"

That was worth some chin scratching. "I'm not sure. There's only so much material to work with, but I could certainly expand my shoes. Maybe use some of the hand-towels from the bathroom for the padding."

"There you go. Four more inches, say, will put you in a whole new category of big. And speaking of the bathroom—"

"Oh. Want me to carry you in?"

She shook her head as she levered herself up to sitting position. "I'll hop. I just hope automated hotels here have the standard amenities."

"Like toilet paper? Of course! There'll be dispensing mechanisms for—"

"I'm not worried about wipes, my dear. Hold on, I'll be right back."

After the toilet flushed and I heard water running in the sink, she came hopping back into the room holding a small collection of miniature bottles in one hand.

"We're all set," she stated with quiet satisfaction. She put the bottles on a nightstand and sat down on the edge of her bed. I noted how smoothly she levered herself down using a single leg, how controlled and easy the motion was. Piece by piece, I was assembling a bizarre theory about my only friend. . . .

"Set to do what?"

"See this shampoo?" she asked, pointing at a tiny bottle. "Could you ask for a better pink?"

"Very pretty."

"We're not aiming for pretty. We spread it out thin, dry it out using the blow-dryer from the bathroom, which you will be a good boy and fetch, and then put little lumps of it all over your face."

"Ah. Artificial acne?"

"Some disfiguring disease. We don't need to be specific. People are going to take one look at you and look elsewhere pretty damn quick."

"And no one will see my big nose."

"They'll see, all right. I have very special plans for your nose. That's what the hair conditioner is for. *Now*, why are you grinning?"

"Just wondering if my nose runs in the family."

As she grinned back, I got a warm feeling, a glow. I'd never experienced the sensation before. If this was what it was like to have a friend, I liked it!

But when she began working on my face and was standing very close in front of me, I noticed something odd: Her breath was very, very fresh. Minty, as if she'd just brushed her teeth. But I'd already observed that there was no toothpaste or toothrinse in the bathroom and we certainly hadn't packed any toiletries for our jailbreak. I didn't know why, but her breath of fresh air made me uneasy. . . .

The private data booth in the First Bank of Sothis stank of some appalling cologne. Funny, how people can become so inured to the scents they wear that they wind up applying enough to become a public hazard.

I'd chosen a bank terminal because that seemed the most illogical place for an escaped convict to do business. The armed guards sure noticed me, but as Helene had promised, they turned their attention elsewhere almost immediately.

I'm sure my artificially drippy nose brightened their afternoon immensely.

The booth's data membrane offered a palate of thirty different virtual input devices, from a modern thought-controlled and Partner-mediated datasphere, to an almost prehistoric keyboard-and-track-ball arrangement. The input device I used wasn't one of the listed options.

Sothis's city server was highly cooperative and clever enough to find its way around a dozen high-level prohibitions without raising a virtual sweat. But the information it spewed forth was truly upsetting.

According to confidential prison records, there had never been a prisoner at Canicula Penitentiary whose first name was Helene. Scrolling through the holograms of Canicula's female prisoners wasn't a lengthy chore and I found my Helene in two seconds. She was listed as one Debra DiMaris and when I read how she was categorized, I felt like I'd been punched in the chest. She was described as a deadly spy and subversive working for Raven Valter, the Dominator of Barnard's Star, that power-ravenous, hate-filled dictator whose savage armies had gutted three Commonweal worlds . . . so far.

And my good deed for the day? Freeing one of the Dominator's servants!

In a strange way, the information helped support the wild idea I'd gotten about Helene. From her strength, speed, coordination, and knowledge of disguises, I thought she might be one of the almost legendary "avatars": mercenary secret agents, all from the same unknown world, who were rumored to have all sorts of interesting and highly illegal genetic modifications. It occurred to me that if avatars still existed, the Dominator would be sure to hire as many as possible. On a sad premonition, I hurriedly sent a command through the network, adjusting the individual processor in room 314 of Eigeron's Hospitality, modifying its buffer protocol. If Helene was a top spy, she might know a few data

tricks herself.

The other news was equally disturbing, but in a different way. Someone had uncovered my handiwork at the train terminal and had learned that Sothis City had been our destination. This should have been impossible. I'd been careful to leave no signs of my machinations. I had no idea what to make of this, but there was also a shred of good news. Apparently, we hadn't been traced to the hotel. Yet.

Heartsick, disoriented, and more than a little frightened, I arranged to have the server generate ramifying false trails if anyone should happen to get a line on me again. I also had the system print out a goodly amount of hard currency, produce some perfect fake IDs, and book passage for two (on the starhopper *God-dard*) to Earth—still the best planet in the known Universe for fugitives to vanish. I wasn't sure I'd be using my ticket or allowing Helene—Debra to go with me if I did, but it seemed sensible to have the option. Finally, I used the server to procure a medical Partner, which would be packed and waiting for me at the service entrance to a nearby hospital. Internal records would show this as a short-term emergency transfer to another hospital.

Despite my hurry to get back to Helene, after picking up the med-Partner, I stopped to buy some self-heating dinners and self-cooling beverages from an inconvenience store. I'd worry about trivia like clothes and toothwash later. The store shared a wall with a nightclub and the throbbing bass guitar was a subterranean rumble that forced the clerk and me to conduct our simple business with shouts and complex gestures.

And then, because of the communications delay, I didn't quite make it to the hotel before I got caught in what Nintuans call a "lead rain," a violent thunder-shower so drenching that it scrubbed my makeup off as effectively as sandpaper. It felt like divine commentary on my good intentions.

Just as I stepped into our room, leaving visibly damp footsteps on the dirty tweed carpet, the shower began running. The bathroom door was cracked open very slightly and steam was wisping out. Must be challenging, I thought, to shower while standing on only one leg. I shook myself off, put down my packages, and hurried over to the digital membrane, switching it to a commercial newscast.

A man with dignified silver hair and a peroxide smile was outlining the latest efforts to forge a Commonweal alliance against the Dominator. Sadly, three of the Commonweal's four major factions—the Jingua, FreeWorlds, and Dharmayuga—still couldn't see eye to eye, or even eye to chin. In truth, the endless meetings and speeches were all what the pundits were calling "ersatzpolitik." So long as Raven Valter was subverting and then conquering unaligned, undeveloped worlds, he was working in the selfish interests of the squabbling factions by preventing a fifth faction of unaligned worlds from developing.

I minimized the newscast. I found it depressing, but I planned to be watching it intently the instant I heard the shower stop.

My electronic escape hatch in place, I set about seeing what, if anything, Helene had been processing in my absence.

Damn! She wasn't just good, she was alarmingly better than I would have believed. All the little caches and buffers that retain information trails for faster re-accessing had been cleared and skillfully overwritten. If I hadn't set up an extra, hidden cache while I'd been in the bank, I wouldn't have even known that she'd used the room membrane.

But used it she had. She'd not only tapped into the highly-protected prison database, she'd broken into its most secret files. She knew who I was, and worse, she knew about the—

Suddenly, I was shocked to realize that Helene was standing right behind me. The shower was still running. I'd been so upset at my latest discoveries that I hadn't paid proper attention to the momentary increase in sound while the door opened wider. I hadn't heard or felt her hopping over.

I turned and our eyes locked. Her intense blue eyes were steady, wary, but far from terrified. She was wearing nothing but a towel around her torso and another cocooning her hair. Her legs glistened damply and her neck had two thin trickles of water running from beneath the towel down to her smooth shoulders.

"You're Karl Peak, I gather?"

"I'm afraid so."

"Born in Cavan County, Ireland, on Earth in 2193. Moved with your alcoholic father to the Starhopper Construction Center in the Kuiper Belt when you were seventeen."

"That's what the records show. I know the history, let's not repeat it."

"Peak the Unspeakable."

"My favorite nickname." I heard myself sigh. "Here's what the Free Associated Press once called me, and I quote: 'the most vicious serial killer in recorded history,' 1,703 victims. Quite the career. I'm surprised you're willing to stand so close to the devil."

She shrugged with only one shoulder. "Perhaps I'd be more cautious if I hadn't also found out about the experiment."

I turned away from her and back to the digital membrane, closed all its open files, and restored the seascape. Oddly enough, the image was now quite precise, only a few thousand pixels short of "parity" resolution. Even the waves were rolling in the right direction. I made an effort to keep my voice neutral as I asked, "How much, exactly, did you learn?"

"Enough, I think." She hopped forward and put an arm against the wall for balance, or maybe she just wanted to see my face. I looked over at her. The

thin hotel towel around her body had slipped down an inch or so, but she didn't seem to care. "Enough to explain all your sly tricks. Apparently, you escaped execution by volunteering to accept a new kind of Partner, a 'virtual conscience' that keeps your . . . bloodier impulses in check. True?"

"It seemed better than death."

"I'm sure. And it looks like the experiment worked. Your records show that you haven't killed anyone in the last two years. That's a long dry spell for Peak the Unspeakable. Don't try to tell me you wouldn't have found some way to keep your . . . career going, even in prison. But maybe the experiment worked a little too well, no?"

My heart was pounding hard and I felt as if the room were spinning. I tried to speak, but my throat had clamped shut.

"You've been very, very kind to me, Karl. Solicitous. Is it possible that your Partner's been, ah, *prodding* you a bit? It's obvious that the thing can manipulate data systems like a—"

"But what about you?" I said angrily to hide my vast relief. "What's a mere serial killer compared to the worst mass-murderer of all time? Maybe you're personally all goodness and light, but what kind of person are you working for—*Debra*?"

She stood there as poised as ever, but her eyebrows lifted. "We've both been rather busy, haven't we? So you uncovered my . . . connection with the Dominator. Sounds like you're not too fond of him. Or is that just your Partner talking?"

"I promise you: It's me."

"Settle down, for God's sake! Looks like your new Conscience hasn't enhanced your *judgment*, dear." Now she sounded angry herself. "What in the galaxy makes you *believe* the information you dug up about me?"

"Oh. You're not working for Valter?"

"Hardly. I just needed the cover story."

Irrationally, I felt a second surge of relief. "For what?"

She smiled tightly. "We won't go into

details right now. But my name really is Helene. I won't tell you my true last name."

"Fine. So why tell me anything at all?"

She hopped backward to perch on the edge of my bed and I instinctively spun the chair to face her. "Because I still need your help, Karl. I'll say this much: I was sent here to gather some specific information about the Dominator's plans and I wound up gathering more than anyone expected—much more than I've been able to pass on. More than I was *prepared* to pass on. If you can get me to Earth or any Free-World, there's an excellent chance that Raven Valter won't be pleased."

I was suddenly in a dilemma. If she was telling the truth, I definitely wanted to help her. But if she was lying? I needed some thinking time and I knew how to buy a few hours.

"The thing to do immediately," I said softly, "is to get your leg fixed."

She was shaking her head in admiration. "So you actually stole a med-Partner? Lord! You're good."

"Borrowed, not stole. The damn things are expensive on Nintu; the hospital only had six. Someone could die if we don't get it back. But it won't show up missing in the city's inventory until tomorrow at noon. We'll have more than enough time to get you repaired before we need to return it. So let's get started . . . unless you'd like to eat first?"

"Healing first."

"Then turn over, and I'll unwrap the thing and put it to work."

"Let me scooch over to my own bed."

When she reached her mattress, she lay flat on her stomach and unselfconsciously pulled the towel off, letting it drop to the carpet. I was astonished. For one thing, Peak the Unspeakable had been a sexual deviant of the most violent sort. For another, Nintuans have a heavy nudity taboo and I'd had two years to get acclimated. But then, she knew that Peak's old excesses were being held in check, and she certainly was-

n't from Nintu. Where *was* she from? Her real last name, I thought, could be a clue about the avatar home planet. Assuming she was actually an avatar. . . .

Helene had a beautiful firm body, but I wasn't staring at her attractive backside so much as at the pattern of bruises ranging from purple to saffron from the middle of her back almost to her knees. She hadn't had a relaxing vacation in prison. A wave of tenderness and concern swept me away, and for a moment, I forgot my many doubts about this woman.

The medical Partner was twice the size of the garden variety, but took only half as long to be absorbed. The gray gelatinous mass I'd placed on Helene's wounds shrank visibly as it worked its way through the pores of her skin. Med-Partners have an impressive array of organic microtools for performing complex internal surgeries. They can synthesize nerve tissue perfectly matched to their host, or blood, bone, or muscle as needed. For painful operations, they release local anesthetics that render the patient unreasonably comfortable.

Because of the self-cauterizing nature of laser burns, this was going to be an extremely painful operation requiring extensive debriding and rebuilding. So I wasn't surprised when Helene grew progressively more relaxed. I figured she'd soon fall asleep. I knew I should eat something—my stomach felt like it was chewing on itself and hating the flavor—but I felt strangely unsettled. Also, some constant noise was etching my nerves raw and it took me a surprisingly long time to realize that the shower was still going. Wonderful. They could add reckless use of water to my crime résumé.

A good hot shower with plenty of soap suddenly seemed overwhelmingly desirable. I used the toilet, threw my prison denims into the bathroom's quick-clean unit, and then squeezed myself into the tiny glass stall, grateful for

the hotel's industrial-strength water heater. But after my skin had attained the color of a cooked lobster and I'd flipped the lever to off, I still felt too tense for sleep. My clothes were semi-clean by now and semi-dry. I pulled them on despite the dampness, feeling foolish that I'd become infected by Nintuan modesty. Perhaps I wasn't quite as silly as the natives; I did leave my shoes off. I stepped back into the bedroom and paced softly around the small area.

On my second circuit, I slapped my forehead. Helene had *already* bathed and had been in the bathroom, door cracked slightly open, peeking out through the small gap, waiting for me to return. When I'd entered the room, she'd quickly activated the shower to make me think she'd be occupied for a while. She'd evidently wanted to see what I'd do if I thought I had some guaranteed moments of privacy.

I should've known something was wrong. If she'd just turned on the shower, why would steam have already been wafting into the room? Sure, there could've been innocent explanations, such as her temporarily turning off the water to lather up, but I hadn't even considered the *possibility* she was up to something.

Just how far in over my head was I?

Pacing didn't seem to help. I turned off the ceiling light and stretched out on my saggy, undersized bed. The digital membrane automatically faded to a night scene. Same beach, but with a lovely full moon. I stared up at ceiling cracks and peeling paint brought into sharp relief by tropical moonlight. If there was a meaningful pattern up there, I couldn't see it. Too damn tired to shut off the membrane's display entirely, I closed my eyes and began drifting into an unpleasant dream.

"Karl?" It seemed as if only a few seconds had passed since I'd closed my eyes. "I'm burning up. And I'm absolutely *starving*!"

I felt like a tiny passenger stuck inside some huge robot that had been rusting away for centuries, but I managed to crank myself upright. "Sorry. I should have warned you, Helene." Even my voice sounded rusty. "We're in kind of an emergency situation here and I set the med-Partner to work extra quickly. Your metabolism must really be, um, cooking by now." I forced myself to stand up and reached over to put my hand on her bad leg. Sure enough, the wounded area felt so hot, it was almost unpleasant to touch.

"How in the world do you 'set' a med-Partner? Never mind! Get me a cold, wet washcloth. Then let's eat first and talk later!"

"Definitely. I could eat an entire Kentian dread-lizard. Claws and all!" After I provided the washcloth, I opened two of the packaged dinners, ripped the tape off all steam vents, pulled the heating tabs, and extricated two pairs of plastic chopsticks. The triggered exothermic reaction took less than a minute to work its wonders. Wonderful smells filled the room.

"Where did you get the flash-food?" she asked.

"There's an inconvenience store right down the street."

"What's an inconvenience store?"

"Local slang. A place you shop when it's—"

"Inconvenient to go somewhere better. I should've known."

We ate with a fury that precluded further conversation and when she'd polished off hers, she asked for and consumed another entire dinner.

"Why," she asked when she finally slowed down, "did you say we were in 'kind of an emergency situation'?"

"Oh. Maybe I should've mentioned it, but I found out from the city server that someone had traced our path as far as Sothis. I can't imagine how they—"

My companion was staring at me in shocked disbelief, but what really interrupted my sentence was an odd crack-

ing thud from somewhere in the building.

Helene threw down her chopsticks, stood up without worrying about such niceties as clothing, tested her bad leg by putting some weight on it, and then sprang to the door with only a faint hint of limp. She opened the door very slightly and very quietly and listened with total concentration. Two minutes passed before we heard another thump. A minute later there was another. With an open entrance, it was obvious that the sounds hadn't come from this floor.

After two more thuds, Helene pulled the door fully ajar for a moment and stuck her head out far enough to look both ways down the corridor. A stray housefly, whose ancestors had doubtless troubled the garbage pails of old Earth, came streaking toward the doorway with a faint buzz, drawn by the smell of food. Without looking, Helene batted it out of the air. I heard it hit the wall on the far side of the hallway and imagined it falling to the carpet, lying with its legs in the air for its last pathetic buzzes. I'd never seen anyone's hand move that fast. . . .

My strange friend closed the door as gently as she'd opened it. "Damn straight," she said quietly, "you should've told me. The people who are hunting me—hunting *us*—are more dangerous than you could believe. And I'm not talking about the cops. We've got to get out of here. Right now."

I'd had no idea anyone unofficial was hunting us, but her urgency was infectious. "Okay. Get dressed and we'll find another bad hotel."

Her prison denims were a shapeless mass on the floor, glowing a poisonous green. Without contact with her body, they'd reverted to their original purpose, but that was easily repaired. She'd pulled them on and was tugging on the zipper when we were both startled by what sounded like an explosion not far down our own hallway.

Helene's eyes scanned the room, resting

briefly on the ventilation duct, which was far too small for even her to squeeze through. Nintuans aren't big on silly extravagances such as emergency exits. She shrugged and finished dressing. Just as she pulled on her second shoe, something smashed the door wide open.

One twisted hinge was all that kept the door attached to its cracked jamb. Backlit by dim hall lights and front-lit by digitized tropical moonlight, a man bounded lithely into the room. From the violence and power of his attack on the door, I would've expected a titan; but this fellow was inches shorter than me. He flipped on the overhead lights and gazed at us calmly, but with complete attention.

His expression was so unfamiliar that it took me several seconds to realize that I was staring at Phil, the big-headed guard from Canicula Penitentiary; I'd never learned his full name. Even when I recognized him, I hardly recognized him. He stood balanced on the balls of his feet looking competent, alert, and dangerous. Professional. Not the least bit stupid.

"Phil the guard," Helene said quietly. "It figures. How did you find us?"

"Why should I tell you?" He was simply asking. His voice was different, firmer. Even the cloud of raw onion fumes was missing.

"Why not?"

He nodded as if she'd made a telling point and pointed a finger at me. "Your big traveling companion provides a fair beacon. I've just broken into seven rooms in this so-called hotel—out of thirteen where you could've been hiding—and yours is the first whose digital membrane is showing a clear picture. You've used it, haven't you, Karl?"

"Maybe." My stomach was clenched as if it were expecting the next punch. "Why should that make any difference?"

"Because that very special Partner of yours always gets the red-carpet treat-

ment from every other Partner. I figured this out while you were still in jail. Every time you touched any digital interface, your requests got A1, top-level priority. But that's not all. The interface would then *voluntarily* rebuild itself to become more efficient at carrying out similar requests. Your Partner must be the damn . . . Binary King or some such." His single bark of laughter sounded like an audible sneer. "The lowered . . . data impedance was detectable even when the information itself was overwritten."

"I'm not quite following you," I said, feeling sick and trying not to show it.

"Maybe you don't *want* to follow me, buddy. But I'll give you an example. Any idiot could guess that you'd be heading for the nearest train terminal after you escaped Canicula."

I had a sudden memory of Phil clumsily backing into Warden Mogis in the operations room, giving me just enough time to get the shock-pistol in place. "You helped me escape, didn't you?"

"Obviously. So, I got to the terminal and did some testing. Guess what? Buying a ticket to Sothis took fractionally less time than buying a ticket to any other city big enough for you to hope to stay hidden. Of course, only a Partner could detect a difference of four nanoseconds, but then, *my* Partner's a real beaut."

Now that I understood the problem, I could prevent it. Unfortunately, it was exactly too late.

"Why did you help me escape?"

"He wanted you to help me escape," Helene declared firmly. "He wasn't authorized to run the prison lasers, but he hoped your special Partner would be able to. And I suppose he guessed that you'd be safe from Furies. He wants to . . . question me in private, Karl. Find out exactly what I learned in jail, how much of it I've been able to pass on. *How* I passed it on."

My face suddenly felt cold and stiff. I knew what she meant by "question me in private."

Phil smiled with perfect confidence,

and perfect teeth. "Certainly, I'd appreciate knowing what you revealed; it's not too late to modify our plans, but I'd rather not change them unnecessarily. As to *how* you communicated, that I already deduced. You set up a simple code with your fellow misguided fools. I'm talking about the avatars secretly monitoring Nintu's Gamma 17 satellite."

Helene looked stricken, but kept quiet.

"You thought I didn't know you'd hacked into Gamma 17? Didn't you wonder why that was the only satellite you could gain access to? Face it girl, you and your allies are utterly outclassed. As the Master says: Truth is strength. Anyway, you obviously set up a kind of visual code and a sacrifice play; I imagine you drew the short straw, eh? You were after some specific piece of information about the Master's plans—perhaps which planet he was going to liberate next, or the exact date our next strike was planned."

My wild theory about Helene being one of the supposedly near-superhuman avatars was clearly dead on, but the confirmation brought no joy. Obviously Phil had been cut from the same kind of genetic cloth. "I take it," I said, "this 'Master' of yours is Raven Valter?"

Phil ignored the question and ignored me. "Your team must've made quite a long list of possibilities, girl. Then you got yourself thrown into Canicula, labeled as one of the Dominator's loyal servants. Shame on you for that! In jail, you tricked or corrupted one of our true servants into revealing whatever you wanted to know. That part was smoothly played, I admit. I still don't know what fool was so foolish or what he or she told you—but very soon, I promise you, I will know those things and so much more."

"Go on," Helene suggested as if she were fascinated by his revelations.

"I intend to. Once you had your information, you watched for a clear day and waited until Gamma 17 was overhead. I knew the satellite had to be part of your

communications plan, and would require line-of-sight. So I made sure that friend Karl was in the operations room whenever Gamma 17 was above, just in case you might need some timely assistance." He chuckled. "Finally you made your supposed escape attempt. At first, I thought you might have a built-in organic transceiver, and I'd prepared for that. But when I saw you running in such a straight line, I understood your plan. Crude, but slightly clever. The precise direction you ran in, maybe even how quickly you ran, told the observers which possibility on the list was correct."

As he was droning on, I was gradually shifting my weight off the bed and onto my feet. Perhaps, if I rushed him fast enough...

Helene turned toward me and shook her head slightly. "You can't do any good here, Karl. Please just stay out of the way."

"He's planning to torture the truth out of you," I pointed out unnecessarily.

"Occupational risk," she said, shrugging while turning back toward our uninvited visitor. "But Phil, or whatever your name really is. You took quite a risk. What makes you think that I haven't picked up additional information and already contacted—"

Phil was smirking as he interrupted. "Aside from you, Helene—or whatever *your* name is—there are no disloyal avatars left on Nintu. None. I've seen to that. Naturally, I have normals watching the Master's more humdrum enemies. Since you escaped, you haven't even been *close* to anyone we consider a risk." He lifted his hand as if to forestall an objection. "I've also made sure that you couldn't get even the shortest message through to any starhopper or to any other planet."

"You've been very efficient," Helene stated with apparent sincerity.

"Efficiency is a by-product of wisdom. I can't understand how you and your fellow rebels can fail to see the Domina-

tor's greatness! Is he not the Just Gardener of the Galaxy, pruning only the sick and unworthy?" Phil's round face, which I'd always thought so dull, was radiating an ardent belief. "And who else would have the vision to offer genetic . . . specialists like us such a magnificent place in history?"

"I can't tell you how delighted I am," Helene replied lightly, "that your sick worship of the Dominator is so uncommon back on—back home. Doesn't Valter's unpopularity among our free people tell you *something*?"

"*You lie!* Every avatar worth—"

That's as far as he got before Helene launched herself at him. Her attack was a complete surprise, to me at least. One moment, she was sitting on the bed, apparently calm and relaxed. The next moment, she was in flight, spinning, her legs scissoring around so quickly that they whistled as they cut the air. One foot was flashing toward Phil's neck, the other toward his crotch. He made no effort to block the strikes—there was too much power behind them—but he could neither duck nor leap upwards, or move forward or back without getting hit somewhere.

Instead, he jumped sideways toward the nearest wall. One of Helene's shoes brushed his crew cut in passing. I was sure he would smash into the plaster headfirst or crash right through it. He did neither.

I couldn't completely track what happened next, but I got a series of blurred impressions. I think his arms flashed out, fingers spread widely. As his arms touched the wall, he kept them extended and allowed his legs to swing up over his head, pure momentum keeping his arms glued in place. His spine seemed to bend backwards as easily as a rubber band. When his feet hit the wall, he somehow straightened his torso and instantly pushed off toward Helene. For just an instant, his body was dead horizontal, face towards the ceiling. But then he began spinning like some insane

torpedo equipped with unfolding arms and legs.

Now it was Helene's turn to avoid whistling limbs. To my amazement, she managed a standing back flip, landed on her mattress, and bounced right back when the immediate danger had passed. Phil also landed on his feet, whirled to face her, and the two of them were suddenly still. Neither was panting or even breathing hard, and neither appeared to have raised a single drop of sweat. For a moment no one moved. Then they began circling each other with tiny sideways steps, open hands held almost nonchalantly in front of their bodies. As they moved, the hands kept shifting position very slightly as if they were subtly playing some childish game like paper-scissors-stone whose rules only they knew.

But everyone knew how the game would end. Perhaps Helene had built-in avatar compensations for her smaller size and more delicate musculature. But she was still somewhat injured. Even I could see that she was favoring one leg.

As Phil passed near me, I could smell his breath. It was unnaturally fresh and minty. The characteristic was probably built into avatars; no wonder he'd always chewed raw onion and minty gum! Avatar breath could be a real giveaway.

There was a brief flurry of motion accompanied by a short barrage of thuds and slaps and then the combatants were circling slowly once more. But two knuckle-sized bruises were blossoming like red roses on Helene's left cheek, and a larger bruise was developing on her left forearm. Her limp was more pronounced. The med-Partner couldn't do a thing right now. As long as adrenaline was coursing heavily through her body, it would know enough to avoid making her sleepy.

Obviously, I was physically over-matched here to an absurd degree. Nevertheless, the hierarchy of my programming insisted that I do everything in my power to help Helene. And I wasn't en-

tirely helpless. If I could get one hand on Phil, even for a split second . . .

I waited until his back was towards me, then I sprang off the bed, arms outstretched. Even as I was in midair, I saw him shift position and knew that he'd heard me coming. But he wasn't worried about me. Instead, he jumped at Helene so fast that he managed to get past her guard long enough to kick her in the abdomen. She slammed against the low dresser behind her and her head snapped back far enough to shatter the dresser's attached mirror, which instantly resembled some diseased spider-web. A few jagged shards of glass went flying. I was afraid Helene had broken her neck.

At the last moment, Phil spun and casually struck me across my right cheek with the back of his right hand. For an instant as I fell, I felt everything. My entire jaw had been knocked loose and I had the unfamiliar sensation of cold air rushing across my teeth even though my mouth was closed. I had just enough time to reach the brilliant conclusion that my cheek had been cut wide open when soft velvet shadows suddenly blanketed my senses and I could no longer feel anything at all.

When I finally went through the vast trouble to open my eyes, the room was filled with the rose-gray light of earliest dawn. I turned my head far enough to see that the digital membrane had been set on a window mode and was now showing the street-level view outside the hotel. Someone must have wanted to keep the hotel entrance under observation. My jaw felt fine and several teeth, which I thought had been knocked loose, were firmly back in place. When I touched my cheek, I touched nothing but unbroken skin and a little stubble. I was starving, but food could wait.

I turned my head the opposite way and saw Helene staring at my face. I was thrilled that she was alive, but for the first time since I'd known her, her eyes

looked at me with real fear.

"What finally gave me away?" I asked, my voice coming out surprisingly weak and hoarse.

"Phil knocked you *all* the way out," she said. "There was no doubt about that. When you hit the floor, your eyes were wide open, but you weren't moving a muscle. I was sure you were dead."

"I thought *you* were dead," I replied mildly.

"I hit my head pretty hard, but we avatars have tough skulls. Phil turned back to deal with me, and your hand shot out and grabbed his ankle."

"Maybe I wasn't completely unconscious."

"Like hell. You were *gone*. When an avatar hits a normal . . . they stay hit. But then, you're not exactly a normal, are you?"

I had nothing to say to that.

She nodded grimly. "He pulled your hand off plenty fast and you didn't move again, but he suddenly got the strangest look on his face. Then he just plain collapsed. He's still sleeping over there on the floor. He snores now and then. I've got him tied up pretty good with blankets."

"That's nice."

"When I went to feel for your heartbeat, the med-Partner practically leaped from me to you. I've never seen that happen before. It went to work on your split cheek right away."

"And your conclusion?"

"You aren't," she said in a monotone, "human."

"What am I, then?" I asked, even though it was obvious that she knew.

"You're the Partner, the virtual conscience. What I don't understand is what you did with Karl Peak. Did you just . . . take him over, or did you kill him?"

"I'm afraid he's gone."

Her face tightened even more and her eyes grew even more wary. "How could you *do* such a thing? Doesn't your . . . programming prevent you from attack-

ing your host?"

My eyes burned with involuntary tears and despite all my efforts, my hands and voice shook as I spoke. "You're talking about my . . . original sin, the bloody stain I can never wash away. My *programming* is all about protecting people, and when I began understanding Peak's intentions, I had no choice at all. None. But what a conflict! I didn't know what else to do but . . . erase the patterns of his self-awareness. Took me a month to figure out how to do it without frying his entire brain. Neurosurgery from within. If he were alive, I'd be forced to murder him all over again." I managed to choke back a sob that struggled to burst forth. If I let one out, enough would follow to shake me apart. . . . "I'm not built for killing."

Helene nodded with slow understanding. "He was planning to hurt someone?"

"Oh, yes. Remember when you said that without a virtual conscience, his career would've probably continued, even in prison?"

"I remember."

"You can't imagine how right you were. Peak was a genius. Do you know how he was finally captured?" She admitted ignorance by shaking her head. "Well, he *wasn't* captured; he turned himself in. That's when he made his first and only mistake. He chose a world where the death penalty was outlawed, but he hadn't properly weighed his own reputation. He was raging when the planetary senate quickly passed a new law specifically for him, making it possible to execute anyone who'd murdered over a thousand people. But the new law made the authorities so uncomfortable, they gave him a choice: death or me."

"Why did he turn himself in?"

"For fun. He'd read about the tight security measures at Canicula Penitentiary and thought it would be a lark to get himself incarcerated and go on a whole-sale killing spree *inside* an ultra-security

jail."

"Good God. How did he expect to get away with it?"

"Microsurgery. He put tiny organic canisters filled with all sorts of deadly but undetectable toxins inside his skin—my skin. The canisters won't appear on scans or x-rays. They look like harmless little freckles from the outside. Squeeze one hard, and enough deadly gas squirts out to massacre a mob. Of course, he made himself immune."

I could see Helene's throat working as she swallowed. "Is that what happened to sleeping beauty over there?"

I was shocked at the suggestion. "Certainly not! The poisons are lethal and opening any canister would've killed him . . . and you, too."

"Then what *did* you do to Phil?"

"Nothing permanent. Remember how he bragged that he had a highly advanced Partner? That was all I needed to know. Even when my human body was knocked silly, I could still revert to my native senses and abilities. Partners have to understand their surroundings and act in certain emergencies, you know. I galvanized my arm muscles into moving and managed to touch Phil's leg. Then I simply ordered his Partner to put the man to sleep and keep him that way until I say otherwise."

"Incredible! Lord, have I ever underestimated *you*. Tell me something: Why do other Partners take your orders?"

"I'm not sure myself. I think it's because of what I am and what I've become. I started out as a new kind of top-level Partner, perhaps more alive and conscious than my kind has ever been. And then I wound up . . . kidnapping a human brain, running myself in parallel with its higher functions and its—its memories." Unbearable memories, and when I experienced them, it was as if I had done all those hideous things. It took a moment to regain control of my voice. "To other Partners, I seem to be a unique hybrid, some kind of super-Partner. I guess that's what earns their re-

spect."

Helene's eyes had lost their fearful, suspicious gleam. She was regarding my shaking hands with genuine empathy. She looked back up at my face and her mouth softened. "I just now realized how young you must be. Weren't you only created a few years ago?"

"I've lived for two years, two months, one week, six hours, seventeen minutes, thirty-four seconds, and change. I always know what time it is, but I don't know what the hell I'm supposed to *do*. Yesterday, you told me that you needed my help. Fine. If you're fighting the Dominator, I'll give you everything I have. It's more than just programming that makes me want to stop Raven Valter! But I need help, too. I'm living in a man's body—a *bad* man's body!—but in so many ways I'm still partly an infant. Will you help me . . . grow up?"

Helene stepped close, put her hands gently on either of my face and kissed me on the forehead. "Count on it. But from what I've seen, you're already more mature than most people try to be. Besides, you may just be the weapon against Valter that my people have been praying for. Consider this: His armies are *modern* armies, and you'll never guess what controls all those bombs, tanks, starhoppers, and control centers."

Suddenly, I was smiling. "Oh, my! I can't believe that I never thought of that! I could shut down his control centers with one touch!"

Helene grinned right back. "We'll try to arrange some convenient opportunities for that sort of thing. How long will Phil sleep?"

"I'll make him sleep until noon. By then, we'll have you completely healed, have the med-Partner back where it belongs, and be on our way to Earth. We can start planning my new career on the trip. But right now, let's eat! There should be two instant dinners left if you haven't eaten any while I was sleeping. Even Partners get hungry, you know."

"So do partners. My turn to cook." ■

THE REFERENCE LIBRARY Tom Easton

Vitals, Greg Bear, Ballantine/Del Rey, \$24.95, 357 pp. (ISBN: 0-345-43528-1).

A Working of Stars, Debra Doyle and James D. Macdonald, TOR, \$25.95, 364 pp. (ISBN: 0-312-86411-6).

The Ballad of Billy Badass and the Rose of Turkestan, William Sanders, Wildside, \$15.95, 285 pp. (ISBN: 1-58715-485-4).

Whole Wide World, Paul McAuley, TOR, \$24.95, 399 pp. (ISBN: 0-765-30392-2).

Alienist, Laurence M. Janifer, Wildside, \$15, 223 pp. (ISBN: 1-58715-500-1).

The Spark of Life, Hayford Peirce, Wildside, \$37.95, 267 pp. (ISBN: 1-58715-550-8).

Adventures in the Dream Trade, Neil Gaiman, NESFA Press (Box 809, Framingham, MA 01701, www.nesfapress.com), \$26 (plus \$3 s&h, \$5 international), 286 pp. (ISBN: 1-886778-37-X) (\$40 boxed, numbered, signed, ISBN: 1-886778-38-8).

Dimensions of Sheckley, Robert Sheckley, NESFA Press (Box 809, Framingham, MA 01701, www.nesfapress.com), \$29 (plus \$3 s&h, \$5 international), 538 pp. (ISBN: 1-886778-29-9).

The word for the day is "dynasty"—if only because I have to start somewhere!

We usually run into the word in connection with history and politics—long familial lines of pharaohs and emperors and kings. Presidents, too—the Adams family looked like it had a good start at one point; the Kennedy clan got cut short by death and scandal; and now we have the Bushes. Is there anything like that in SF? Frank and Brian Herbert and Mike and Laura Resnick probably come as close as anyone to date.

But in the future! Consider the late Poul Anderson. He was an astonishing and marvelous writer who entertained us for the better part of a century. And his daughter Astrid married Greg Bear, who is himself a remarkable writer, and they have two kids.

I have no idea whether those kids show any interest in or talent for writing. But if they do, and if genes have any

thing to do with it all, genetics being what it is, we may well see great things. And we'll be talking about a dynasty.

Which is all by way of leading up to Greg Bear's latest, **Vitals**, a thriller starring twin scientists, Hal and Rob Cousins, who are both seeking the secret of longevity in the biology of the bacteria that live as symbiotes within our bodies. As the tale opens, Hal is riding a submersible into the ocean depths, searching for the remnants of ancient life that may hold the keys to understanding how the ancient symbiosis got started. But even as he is collecting samples of giant cells from the sea bottom, the pilot of his sub tries to kill him. When he makes it back to the surface, he learns that another scientist was hunting for him, gun in hand, and killed others instead. Shortly thereafter, his wealthy funder yanks his support, his lab is trashed, he gets the call that his brother has just been murdered, his

apartment is torched, and a dogwalker sics a pair of Dobermans on him. And he learns that other scientists doing related research are being killed.

It sounds like a plot, doesn't it? It gets still more ominous when a strange, mad historian named Rudy Banning appears, Hal finds a body in a freezer in Rob's lab, and Rob's notes tell a tale of Stalinist Russia and bacteria that take over the mind. Clearly the world has secret masters, and they do not like researchers who retrace their paths. Yet Hal is persistent and fortunate. The secrets emerge, and in due time the world stands revealed for an appalling pretense.

Fortunately, not everyone is ruled by the secret masters. Resistance is possible. The masters' agents can be identified and stopped, government can be reclaimed, the headquarters stormed. Is that enough? Can the resistance win? The novel could easily end either way, and I won't say which Bear chose.

Read it yourself, and feel the cold, cold wind up your shirttails, for this is the sort of paranoid fantasy that makes one pray it is not true.

Bear has hewed close enough to the latest research to let one wonder. There are indeed giant bacteria on the seabottom, and we do indeed have symbiotic bacteria within us—so many in fact that it is not entirely unreasonable to say that we exist for bacterial convenience. There are so many bacteria on and in the Earth that they account for the vast bulk of living matter, and they do indeed seem to communicate with each other. Do those communications amount to a vast supermind that runs the world to suit itself? I don't think so, but . . .

Bear is here much more convincing than he was in *Blood Music* (the expanded version of an *Analog* novelette that won both the Nebula and Hugo awards; reviewed here in November 1985), which dealt with some of the same basic ideas.

Debra Doyle and James D. Macdonald are the authors of the popular "Magerworlds" series, which deals with the conflicts between a more or less conventional interstellar civilization and another where "mages" manipulate luck and probability. (You can see samples from the series' novels at <http://www.sff.net/people/doylemacdonald/magerworld.htm>.) The last novel in the series—*The Stars Asunder*, reviewed here in the February 1999 column—revealed how the conflicts all started. Ages ago, the luck-lines came to be neglected and the galaxy split in two, with the Magerworlds in touch only with each other and unaware that any others existed at all. Only legend remained of a time before the "sundering." But then came Garrod syn-Algal sus-Demaizen, final heir to an ancient estate, a Mage of power, ready to recruit a circle of other potent mages and walk the Void to heal the galaxy. At the same time, politics was busily complicating the picture, pitting the star-lord clans against each other and forcing them to arm. The result, I said in 1999, was an intricate tale, rich in characters and maneuverings and momentum, just the sort of thing that leaves a reader satisfied.

I can say exactly the same of the series' new entry, *A Working of Stars*. It begins with Arekhon sus-Khalgath sus-Peledaen, one of the survivors of Garrod's circle, dreaming that the time has come to return across the gulf that splits the galaxy and finish the job Garrod began. First, however, he must deal with the puzzle of a strange ally, a powerful Mage and Void-Walker who claims she is his own last student come back through time as well as space to assist. He must also gather the other survivors.

Meanwhile, Lenyat Irao, a cargo-hauler in the pay of clan sus-Radal, responds to a mayday call to find a destroyed sus-Dariv convoy with one remaining ship containing one lone survivor who gasps out that the sus-Peledaen are responsible. Shortly there-

after, and well before word of Irao's discovery can reach them, the sus-Dariv clan is all but destroyed by a planted bomb, and the new head of that clan, Zeri, can see no option but to merge the remnants with the sus-Peledaen by marrying Arekhon's estranged brother, Natelth. Fortunately, other figures are in the game as well, and Zeri is spirited away before the marriage can be consummated.

Now Zeri is running, with Lenyat Irao and a Mage at her side. The sus-Peledaen are in hot pursuit, and though they plan to gobble up the remnants of the sus-Dariv clan, those remnants are having none of it. The sus-Radal have a secret base far off in space, and everyone is soon converging on it. Even Arekhon and his crew are heading there for a climactic space battle, heroic sacrifices, and what looks much like a resolution to the ancient problem.

Yet the conflicts are hardly over. There is plenty of room for more novels!

It's a bit late to cover this one, but there is a new edition of William Sanders's **The Ballad of Billy Badass and the Rose of Turkestan** out now, so...

Make Sanders a rich man, will you? The first edition of this book didn't get the play it should have, which is a shame. Sanders is witty, caustic, clever, cynical, and not very PC at all. He is also a heckuva writer who can introduce Billy Badass, an Oklahoma Cherokee whose late grandfather shows up on page one in the guise of a bluejay full of good advice and a warning: "I think there's some really interesting shit about to go down."

From that moment, you are with Billy. You like him, you sympathize with him, and you are prepared to find what his life holds just as interesting as Grandpa Ninekiller does. It doesn't hurt a bit when the next step is a dance social where Billy meets a young lady researcher visiting from the wastes of

Turkestan—this is Janna, the Rose of the title, and she soon makes it clear that the Native Americans aren't the only tribes a dominant culture has stomped on, for her own Kazakhs had been shoved around just as much as the Cherokees. That is not all she and Billy have in common, for they feel a powerful attraction, and when Billy follows her back to Nevada, he learns that she is researching the effects of nuclear testing contamination, something else shared by Native Americans and Kazakhs.

Meanwhile, some New Age chumps get their heads torn off. So do some Indians. Something so dark that Lovecraft could have dreamed it on a bad night is stirring, and the world is about to die.

Unless Billy, his Rose, his grandfather, and a host of victims of oppression can turn the tide.

You'll love it. This man can *write*.

Last November, I recommended to you Paul McAuley's *The Secret of Life*. Now he has a very different tale—a near-future police procedural—that is just as worthy of your attention.

The protagonist and narrator of **Whole Wide World** is John Dixon, a cop so tainted by unjust accusations of cowardice that he has been relegated to clerical work in a London where surveillance cameras festoon every lamppost and doorway. Then his duties bring him close to a bizarre murder. Sophie Booth was strapped nude into a chair in front of her own webcams and brutally slaughtered. The murderer wore a mask and gloves and used a "fluff bomb" to scatter dander vacuumed from bus and subway seats in order to confuse any effort to find a trace of his DNA. There is a porn connection, and an Italian family, and Barry Dean, a nasty little hireling with a perfectly good alibi—he was in Cuba working on the family's porn servers—who taunts Dixon that he's everywhere and he cannot be touched.

Dixon is hooked. He neglects his duties, oversteps bounds, earns reprimands,

mands, and somehow zeroes in on the secrets despite the efforts of even the National Criminal Intelligence Service's computer-crime squad to shunt him aside. What are they? I can't say, but I can offer you some of the same hints McAuley does. His London is both paranoid and repressive. The cameras are one sign, as is the behavior of the software that operates them, searching for crime, traffic offenses, and the like. Dixon remembers seeing a fox caught in a spotlight, running for the dark, but constantly tracked by the swiveling cameras, constantly illuminated, until finally it gives up, panting. Then the spotlight turns off, the software bored. (Sophie Booth's uncle lives near her, and he is the man responsible for that software.)

Another sign is tight controls on information. Porn is forbidden, but so is much else. Movies, for instance, are thoroughly bowdlerized; possession of intact classics is a crime. Freedom is thus a rarity, and Sophie is young, a would-be artist, flaunting her independent spirit by baring all for her web cams and playing hide and seek with the surveillance cameras.

Is McAuley's future unlikely? I fear not, for in the past year, ever since September 11, 2001, we have seen Americans accepting levels of surveillance that would have been unthinkable before. England has been ahead of us in that respect, with many surveillance cameras already in place and government security already sifting through everyone's emails. The regulation of porn and other media content is also possible; the would-be censors are out there, and they're after much more than porn. When the Harry Potter movie was released, they were burning and snipping (where towns refused them fire permits) piles of Potter books. Fortunately, the resistance to censorship remains more active than that to surveillance, at least for now.

Can surveillance be perfect? There will always be holes of the sort that

make novels like this one possible. Can content regulation be perfect? Of course not, not when we have the World Wide Web, better known here as the Whole Wide World, and content can cross borders from places where it's legal (Cuba) to places where it isn't (England).

McAuley is thus writing a kind of science fiction that is hardly science fiction at all. Who knows? By the time you read this review, some of his tale may already have made the papers.

I've always enjoyed Laurence M. Janifer's "Gerald Knave: Survivor" stories, so I'm happy to tell you: Here's another.

Alienist begins when Knave's space-jump goes awry and he emerges into normal space some eleven thousand light years from where he expected to be. This is a puzzle, it is, and it doesn't improve when a rather cryptic voice starts talking to him out of the everywhere into the here, introduces itself as Folla and punts him back to human space in something less than an eye-blink.

Curiouser and curiouser. Especially when Master Higsbee—Janifer's know-all-and-deduce-the-rest Mycroft Holmes figure—introduces Knave to an alien psychotherapist, one of whose patients becomes the centerpiece in a classic locked-room murder, and a strange Folla-like alien named Dube starts showing up in the dreams of people involved in the case, asking them to make a device that will let it visit.

Neither Knave nor Master Higsbee think such a visit would be a very good idea. Dube and presumably Folla do not seem like very nice folks. But they are powerful enough to boot spaceships vast distances and to influence some people to do their bidding. How can they be stopped?

Janifer's answers, involving dreamlands and Josephson junctions, are a bit bafflegabbish, but what the heck. SF does a lot of that, sometimes with great care (as in Greg Bear's *Vitals*) and some-

times with sheer insouciance (as here). The story is what counts, and Janifer keeps it moving right along, in the process giving Knave a new sweetheart from the local police force. It should be interesting to see what Knave and Mirella get up to next.

Janifer's book is an example of the recent explosion of "print on demand" books, made by possible by equipment that can fairly economically print and bind a single copy of a book, working from a computer file. The advantage is that the publisher need not tie up money in a warehouse full of inventory. As a corollary, books can remain "in print" (read: available) far longer than has been the case for decades. The disadvantage is that the technology has attracted a number of vanity-press operations that have seen mainly an opportunity to fleece wannabe writers. This has given "print on demand" a bad name with booksellers and customers.

However, the technology is being used responsibly by many established publishers, both small and large. For SF and fantasy, that means Wildside Press, which has brought many out-of-print novels back into print (right now they're bringing Avram Davidson's novels back in newly typeset, deluxe editions, beginning with the classic *Mutiny in Space*) and has made it possible for established writers to offer their fans short-story collections and novels (such as Janifer's) which publishers such as Ace, Warner, and TOR have not wanted because they could not see sufficient sales in the offing (reasons vary; some novels are rejected because they stink, some because the author's last novel did not sell well, sometimes because the publisher did not print enough copies and would not print more even when customers wanted to buy them; ask Barry Longyear about how this works, or find a copy of the Winter 2001 issue of the *SFWA Bulletin*).

I said "print on demand" was "fairly

economical" because the price isn't too bad for a paperback. It's about what we expect for trade paperbacks done the traditional way. But for hardbounds, the price can seem pretty steep, as in the case of Hayford Peirce's *The Spark of Life*, a modest-sized book that lists for almost \$40 (Buy.com has it for \$29.60). Is it worth it? It's perfectly readable, quite enjoyable, very much a traditional SF adventure, but frankly, I'd rather pay for the paperback. Let's take a look:

The setting is a future Earth where the invention of personal force fields has given individuals and groups the power to tell national and smaller governments to stuff it. The world is divided into a myriad "claves," and in this world Larry Madigan makes his living selling fields and related tech. Until, that is, he is invited by the Venerable Shem to supply his clave and he shows up with his girlfriend, who turns out to be just the gal Shem's cult needs in its mission to breed back to the original Noah. Now Larry is holed up on the bottom of Great Bear Lake in Far Northern Canada in a stolen submersible.

So there's a knock on the door. Or more properly, a "clang" on the hatch. And the next thing Larry knows, he's staring at an unlikely trio of aliens who have spent forty thousand years on the road from Galactic Central in hope of laying hands and tentacles on an ancient device known as the "Enabler," which legend hints can affect the evolution of sentients from dumb brutes. Or vice versa.

So you guys want a hand, huh? Well, first, help me get Erika out of Shem's vile clutches. I know that will tick Shem off a bit, but he already thinks I'm the spawn of Satan. And then we can start searching for the McGuffin. . . .

Unfortunately, Shem locates it first, buried somewhere under the neighborhood once marked by Bar Harbor, Maine, and conquers the local clave. Now it's a race to see who can dig a tunnel faster. And then . . .

Peirce doesn't tie up his loose ends. He unifies them, and I'll let you read the book to find out what *that* means.

Neil Gaiman established himself with remarkable graphic novels (*Sandman*). In February 1991, I reviewed favorably his collaboration with Terry Pratchett, *Good Omens: The Nice and Accurate Prophecies of Agnes Nutter, Witch*. Last year, he published *American Gods* to an excellent reception, and this year he was guest of honor at Boskone, the Boston-area SF con. To honor the occasion, NESFA brought out **Adventures in the Dream Trade**, a major part of which is Gaiman's "blog" (weblog) chronicling the proofreading, touring, and autographing chores that went with *Gods*.

That is perhaps enough for Gaiman fans or would-be Famous Writers. For the rest of the world, Gaiman includes a number of poems, song lyrics, short stories, and essays (most written as introductions to other folks' books). The overall flavor is quite charming, for Gaiman is witty, inventive, congenial, and fond of making things "story-

shaped"—and nowhere more so than in a poem he did *not* include here.

Last winter, I heard him recite "Crazy Hair" at a performance at MIT, where Gaiman, Harlan Ellison, and Peter David entertained a large audience for hours. He wrote it, he said, for his daughter, and it was astonishingly full of fancies about what lives or nests in, visits, tours, and adventures in his expansive hair.

Maybe in his next book . . .

NESFA has also brought out **Dimensions of Sheckley**, an omnibus of four Robert Sheckley novels—*Immortality, Inc.*, *Journey Beyond Tomorrow*, *Mindswap*, and *Dimension of Miracles*, and one novella, *Minotaur Maze*—with an introduction by Mike Resnick (who calls *Dimension Sheckley's* masterwork) and an afterword by Tom Gerencer.

At his best, Sheckley is a witty, satirical, cynical, skeptical genius who takes the genre in new directions (also known as giving the rest of the gang new toys to play with). Don't believe me? Try the book. It's Sheckley at his best. ■

What a man knows is everywhere at war with what he wants.

—Joseph Wood Krutch

Satisfy your hearts with food and wine, for therein is courage and strength.

—Homer

Dear Editor:
I have followed with interest Robert J. Sawyer's serial "Hominids." Its portrayal of advanced Neanderthals is striking for the way it avoids the temptation to show them as merely differently-built versions of ourselves. Its conclusion in the April issue, however, rests on questionable assumptions in both physics and anthropology.

Physics first. Sawyer posits a version of the "many worlds" model of quantum mechanics in which all of the divergent timelines arise from conscious choices made by human beings (of one species or another)—except for one primordial case, in which the split happened randomly as in Hugh Everett's hypothesis, giving rise to consciousness (in *Homo sapiens* in one timeline, and in Neanderthals in the other). Leaving aside the observation that unless consciousness is unique to this planet, splits should have been generated long before that on the basis of consciousness in alien beings (although of course that would not affect the events of this story), why should an Everett-style split happen only once (even on Earth), and only to determine which hominids received the gift of consciousness? This suggests divine intervention rather than a natural phenomenon. Surely that is not what Sawyer intended.

As for anthropology, the idea of a "consciousness revolution" some 40,000 years ago in Europe being the reason modern humans finally prevailed over Neanderthals has come under attack on the basis of fresh evidence. Finds in Africa of technological and cultural in-

novation dating back as far as 90,000 years have challenged the idea that the so-called "dawn" happened at all, at least in the abrupt and localized manner once imagined. Moreover, at least some evidence calls into question exactly who produced the Upper Paleolithic relics cited as evidence of the "dawn"; some of them, as is the case with at least one find in France dated at between 39,000 and 34,000 years old, are found associated only with Neanderthal bones. And despite claims that Neanderthals were simply wiped out by the presumably superior Cro-Magnons, researchers such as Dr. Milford Wolpoff of the University of Minnesota have published analyses of fossil remains which appear to show mixed Neanderthal-Cro-Magnon ancestry. Dr. Wolpoff suggests, as do others, that Neanderthals disappeared not through extermination but through interbreeding with Cro-Magnons. Wolpoff also hints that some Neanderthal genes remain in modern humans. If so, it's hard to accept that the two ancient hominid lineages qualify as separate species. (I'm indebted to two recent articles, in the Feb. 26 *New York Times* and the March 2002 issue of *Discover* magazine, for summarizing recent work in this area.)

Eric B. Lipps

The author replies . . .

The job of the science-fiction writer is to find the most dramatically interesting interpretation that doesn't contradict established fact. Mr. Lipps can say "calls into question," "if so," "suggests," and "hints" as much as he wants, but all that

means is that science is undergoing its normal back-and-forth.

Louise Benoît, the character who advances the modified multiple-universe theory in "Hominids," is just giving her best guess, one possible interpretation that fits the facts so far observed. And despite Mr. Lipps's belief that he knows my intention better than I do, he apparently missed that Louise, a Catholic, presents her theory within a discussion of how religious views often color scientific interpretations.

As for the evidence for an ancient African emergence of symbolic thinking, it's exceedingly thin (such things as a stone blade that appears perhaps to have been polished more than was strictly required for utilitarian purposes, and a single rock with crude hash marks on it), and the ages for these artifacts are questionable (the artifacts themselves weren't dated).

And as for my friend Milford Wolpoff (who, incidentally, is at the University of Michigan, not Minnesota), I spoke to him at length while researching "Hominids," and, indeed, he read and commented on the manuscript prior to publication. Milford is the public face of the smaller of two camps of Neanderthal experts; the other camp, often represented by Ian Tattersall of the American Museum of Natural History (with whom I also spoke at length), rejects Milford's position that Neanderthal genes were coopted into our kind of humans. Ian and Milford can't both be right, and, again, I went with the interpretation that best served my dramatic purposes.

Robert J. Sawyer

Dear Mr. Schmidt,

I very much enjoyed Robert J. Sawyer's "Hominids." Good characters, a good story, and a thought-provoking view of what society could be like if there weren't so darned many of us who are violent, greedy, selfish, shortsighted, and/or just plain nuts.

On the other hand, it seems to me

that Sawyer sometimes artificially tipped the scales to make humans look as bad as possible.

Examples: Mary mentions that there is disagreement among scientists about the role *Homo sapiens* played, if any, in the demise of Neanderthals on our world (as there should be, given the limited data). However, Mary's own conclusion is, of course, that we exterminated them.

When Mary tries to explain the Cold War, all she can come up with is the tired old misconception, which seems to be popular in some quarters, that it was about economic systems.

Well, okay, it was partly about economic systems, but that was only one small reason out of several others which I would argue were far more important. The conflict between the United States and the Soviet Union was, in large part, about the same things that conflicts between nation states are always about—control of territory, control of resources, political power and who gets to wield it, and over whom they get to wield it.

There was also the small matter of a society which values and protects the rights and freedoms of the individual, versus a society in which the government sought totalitarian control.

The Cold War was idiotic in all sorts of ways, but claiming it was only about economic systems is an unfair attempt to make us humans look even more foolish than we are.

Maybe I'm just being defensive—it was hard not to be, what with all the human-bashing going on. I realize that limiting Mary's knowledge might have been done to make her a more realistic character, and Lord knows there's plenty about humanity that really is very bad indeed. But while our negatives were explicitly stated, one had to "read between the lines" to see our positive qualities.

David Cederstrom

The author replies . . .

My parents were both economists, so

perhaps I grew up with a more catholic definition of the term “economic systems” than David Cederstrom did. But what Mr. Cederstrom sarcastically refers to as a “small matter”—meaning, of course, that he sees it as in fact a core issue—“of a society which values and protects the rights and freedoms of the individual, versus a society in which the government sought totalitarian control” strikes me as a restatement, in the pro-American rhetoric that Mary would have been spared having been educated in Canadian schools, of the thesis she did, in fact present: that the Cold War was principally about the conflict between the competing economic systems of capitalism and communism.

And there are very few fence-sitters in the paleoanthropology community on the question of Neanderthal genocide. It’s perfectly realistic that Mary would have a strong opinion one way or the other, and if I, as author, gave her the opinion that best suited my dramatic purposes—well, then, I’m doing my job properly.

Robert J. Sawyer

Dear *Analog*,

First, I want to say I loved Robert J. Sawyer’s “Hominids.” I haven’t been reading much SF lately, and I’d meant to let my *Analog* subscription lapse until I got hooked on this serial. So I’m not criticizing, just posing some questions.

Sawyer, through his characters, seems to support the view that Cro-Magnons—our ancestors—hunted the mammoth and Irish elk to extinction. But a recent Discovery Channel program claimed they weren’t hunted to extinction. Rather, those large animals were never very numerous (because they required huge amounts of food), and a relatively small climate change was enough to kill them off. What’s the consensus of scientific opinion here?

Again through his characters, Sawyer seems to support the view that Cro-Magnons killed off the Neanderthals.

This is presented as genocide, about which a character feels guilty. I think the jury is still out as to what caused the disappearance of the Neanderthals, and whether they left racially-mixed progeny. In any case, it’s unreasonable to attribute genocidal intentions to the people of that era, who lived in small groups and had no idea of the larger picture. (I’m sure Sawyer, speaking as himself, wouldn’t do so.)

I’m just a reader with no specialized knowledge. But it’s my understanding that when Neanderthals and Cro-Magnons collided in Europe, the Cro-Magnons lived in larger groups (fifteen or more, as opposed to the Neanderthals’ five to seven). That makes sense, because Cro-Magnons evolved in Africa. Food—especially fruit—was easily available there, and large animals preyed on humans, so they banded together for defense. And they kept that social structure when they migrated. Neanderthals, on the other hand, evolved in response to a harsh environment in which food was harder to come by—but the large animals didn’t kill and eat humans. So the Neanderthals lived by hunting, and each small group needed an extensive territory.

We know the Cro-Magnons developed better weapons. Their spears could be hurled from a greater distance, and did more damage. So when they moved into an area it would have been the Neanderthals who saw them as a threat, rather than vice versa. Doesn’t it seem likely that those small groups of Neanderthals, in desperation, frequently attacked Cro-Magnon settlements and got themselves killed? The Cro-Magnons may have seen them as a minor nuisance, and rarely bothered to hunt down and capture their women.

Why did the Cro-Magnons make “progress,” while the Neanderthals did not? My very unscholarly hypothesis is that group size was the key factor. When a Neanderthal had a bright idea, and implemented it to the best of his ability,

the small "advance" made died with him. A Cro-Magnon's bright idea was shared with more people, with the result that his contribution to society not only outlived him, but triggered more ideas.

Kay Kelly

The author replies . . .

There is no scientific consensus on what led to the extinction of the megafauna, including mammoths, in North America, but the Pleistocene Overkill hypothesis is still a leading contender. After all, overkilling is clearly documented as an extinction mechanism in places that humans came to in historical times, such as New Zealand and Australia.

The notion that Neanderthals and Cro-Magnons had different group sizes is conjectural; there's almost no archeological evidence to support it (we have remains of only a couple of hundred Neanderthal individuals in total from all locales at which their fossils have been found, scattered over the 160,000+ years of their existence).

The inferior weapons Kay Kelly is referring to are presumably the hafted, aerodynamic spears Cro-Magnons developed, in contrast to the thrusting spears that required close-quarters combat with large animals favored by Neanderthals. I discuss at length in "Humans," the sequel to "Hominids," why this might be so (given that the Neanderthals couldn't help but to have seen samples of the Cro-Magnon spears, and, assuming they'd wanted to and were conscious, could have copied them). Here's a sneak peek at a scene in a bar at the annual Paleoanthropology Society meeting where Ponter and Mary discuss this issue:

"You Gliksins drink alcohol, smoke, and engage in hazardous sports to demonstrate your *residual capacity*," said Ponter. "You are saying to those around you: see, here, during flush times, I can run myself down substan-

tially, and still function well, thereby proving to prospective mates that I am not currently operating at the peak of my abilities. Therefore, in lean times, I will obviously have the excess strength and endurance to still be a good provider."

"Really?" said Mary. "What a fascinating notion!"

"I understand it, because my kind does the same thing—but in other ways. When we hunt—"

Mary got it in a flash. "When hunting," she said, "you *don't* take the easy way out. You don't drive animals off cliffs, or throw spears at them from a safe distance—something my ancestors did, but yours did not, at least on this version of Earth. No, here your people engaged in close-quarters attacks on prey animals, fighting them one-on-one, and thrusting spears into them by hand. I guess it *is* the same thing as smoking and drinking: look, honey, I can bring down supper with my bare hands, so if things get tough, and I have to hunt in safer ways, you can be sure I'll still bring home the bacon."

Robert J. Sawyer

Dear *Analog*,

I can remember walking home from the mail box (1/4 mile away from the house) back in the late thirties and reading a story in *Astounding* as I walked home with the magazine. I have tried to read all the issues since then, but of course I have no library full of them, since space and time prevented that.

I am 76 years young and interested in many things, mostly scientific. I am currently dabbling in learning about digital electronics—sure is different than vacuum tubes!

I just finished reading "Hominids" by Robert J. Sawyer. I saved all the issues unread till the final segment of the story arrived and then I am now reading the other stories. Very good and very interesting. And does Mr. Sawyer plan two sequels to the story? In my mind it was left

that way. He could continue with the "Hominids" or with the "Humans" or both. I think that there is enough background to have both being considered as sequels, with then a joining of the two stories.

I also just finished reading "Presence of Mind" by Edward M. Lerner. I feel that the direct interface of the brain to a computer is the next step in the computer world as far as big developments go. I don't see full handshaking in the interface to be developed until after a lot of work is done in being able to "think" and have the computer accept that as a legal command. I think that the computer to brain interface will be harder. (But who am I to play the role of a guru when I barely can use this computer?)

The only time my subscription to *As-tounding/Analog* expired was when I was in the service in 1944-1946.

Donald S. Lambert

The author replies . . .

Mr. Lambert is quite insightful. There will indeed be two more volumes in my Neanderthal Parallax trilogy, precisely as he suggests. Volume 2, *Humans*, will be published in hardcover by Tor in February 2003; Volume 3, *Hybrids* will be out in time for Christmas 2003.

Robert J. Sawyer

Mr Schmidt,

Reading your [April, 2002] editorial this morning, I felt that I knew immediately which camera company you meant, as I have had an almost identical experience with them. My camera originally cost almost \$3,000 (prosumer video) and had few hours on it. It had always been maintained meticulously by a professional firm but nonetheless stopped working. I was told by this company the same thing as you were and when I mentioned that I was angry that they would not support it, their attitude was basically to tell me to go pound sand! I was invited to spend another \$3,800 on a newer version of the

camera. Interestingly enough, when pressed, they admitted that this "new and improved" version used the *exact* same manufacturing method that caused the problem in my last camera (wave soldering of the circuit boards which shortens the life of the hundreds of capacitors on the boards). To add insult to the list of grievances, they also informed me that the thousands of dollars of special lenses that I had purchased over the years were as useless as the camera to me because they had *not* made the camera backward compatible with them! When I asked them *why* I would *ever* want to purchase another product from them, they stated that "our studies show that most consumers replace this type of item in less than six years" I told them that *maybe* it was because it had failed on them and the company would not support the product! At this point I was curtly told that I did not need to become "belligerent"!

Hmmm . . . well, let me tell you what I consider belligerent. I have since been able to cost this company tens of thousands of dollars in lost revenue. Admittedly a small amount in the scheme of things, but a satisfying amount for me. I will continue to do this for the rest of my natural life! I also tell everyone that I talk to about this subject to stay away from this manufacturer and plan to begin to put this information on my website for wide dissemination. I do this type of thing with *all* issues that I feel warrant it.

Which brings me belatedly to the point of this letter. In your position as editor, you have a "bully pulpit" that you are not using to best good of your readers. You had an opportunity to *name names*, sir, and you did not. I kept looking for the name in the text, but did not find it. You *did* give an obscure reference to a slogan, though. I understand the legal ramifications in this, but also know that we have a Constitutionally protected right to this kind of speech . . . *especially* in an editorial format!

I am sorry to see that you chose to pass up this opportunity, but heartened to see you deal with the subject at all. The fact remains that if all of the "sheeple" would take exception with this sort of thing, among other issues, these practices would end! Oh, and by the way, I *also* take the time to write to companies that have *good* practices and tell them, too . . . *and* promote their products!

Jeff Eckes

Good advice in your last paragraph,

but I usually prefer not to name names in such cases. The remote possibility of legal trouble is a minor consideration; even if we win, we don't need the aggravation of nuisance lawsuits. More important is the fact that when I give a specific example, readers too often decide that's what the piece is "about" and ignore the larger principle or trend that it's really about. This is a good case in point: the company you had trouble with was not the same one I had trouble with.

IN TIMES TO COME

Our November issue features the powerful conclusion of Edward M. Lerner's *Survival Instinct*, plus a wide variety of other stories by such writers as Robert J. Sawyer (making a rare appearance with a story that fits in one issue!), Walter F. Cuirle, Dave Creek, Kathy Olton, Brian Plante, and Grey Rollins.

Joan Slonczewski's science fact article, on stem cells and human cloning, is particularly timely, given that science fiction has anticipated the possibilities for decades and now much of the real world is suddenly wishing they would go away. They won't, of course, nor should we necessarily want them to. Dr. Slonczewski offers a refreshingly balanced and sensible look at the prospects, and good guidance on how we might reap the rewards while preventing the perils.

And, along somewhat similar lines, we have the latest update of "Niven's Laws," from Larry Niven. You may have seen some of them before, yet see new relevance in them now; and some of them are "hot off the presses."

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UPCOMING EVENTS Anthony Lewis

4-6 October 2002

ALBACON (Capital-area [NY] SF conference) at Schenectady, N. Y. Guest of Honor—Mike Resnick, Artist Guest of Honor—Tom Kidd, Fan Guest of Honor—Sharon Sbarsky, Special Guests—Sharon Lee & Steve Miller. Registration—\$35 until 6 September, \$45 at the door. Info—Albacon, Box 2085, Albany NY 12220-0085; email—committee@albacon.org; URL—www.albacon.org

4-6 October 2002

ARCHON 26 (Illinois/Missouri SF conference) at Gateway Center Holiday Inn, Collinsville, IL. Guest of Honor—Connie Willis, Artist Guest of Honor—Ruth Thompson, Fan Guests of Honor—Les Haven & Jeanne Norris. Registration—\$35 until 31 August, \$40 thereafter. Info—Archon 26, Box 8387, St. Louis MO 63132-8387; phone—(636) 326-3026; email—archon_hotline@Zurich.net; URL—www.stlf.org/archon/26/index.html

4-6 October 2002

TRINOC-CON (North Carolina SF conference) at Downtown Durham Marriott, Durham, N.C. Guest of Honor—Lois McMaster Bujold, Special Guest—Fred Chappell. Registration—\$30 in advance, \$35 at the door. Info—Laura Haywood-Cory, c/o Trinoc-con, Box 10633, Raleigh, NC 27605-0633; email—info@trinoc-con.org; URL—www.trinoc-con.org

11-13 October 2002

VCON 27 (British Columbia SF conference) at Guildford Sheraton Hotel, Surrey, B.C. Guests of Honor—James Blaylock, Gary Gygax, Tim Powers. Registration—CAD35 (USD25) until 9

September 2002, CAD45 (USD32) at the door. Info—VCON 27, Main Floor, 2216 MacDonald Street, Vancouver, BC V6K 3Y4 Canada; email—vcon@shaw.ca; URL—www.v-con.ca/index800.html

18-20 October 2002

CONJECTURE (San Diego area SF conference) at Doubletree Mission Valley Hotel, San Diego, CA. Guest of Honor—Steven Brust. Registration—\$30 until 1 June 2002, more thereafter. Info—Conjecture, Box 927388, San Diego CA 92192; email—info@conjecture.org; URL—www.conjecture.org

18-20 October 2002

CON*STELLATION XXI—PAVO (northern Alabama SF conference) at Tom Bevill Center, Huntsville, AL. Registration—\$35 until 20 September, \$40 thereafter. Info—Con*Stellation XXI: Pavo, Box 4857, Huntsville AL 35815-4857; phone—(256) 880-8210; email—constell@con-stellation.org; URL—www.con-stellation.org

31 October-3 November

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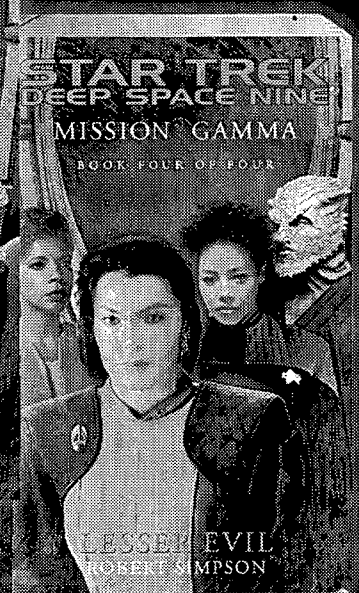
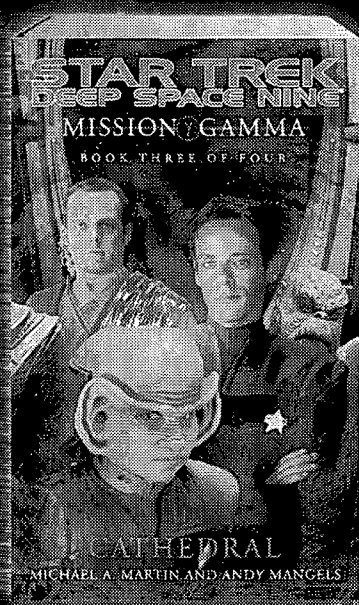
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